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[Journal of the Telegraph.]

THE PRESENT METHOD OF TELEGRAPHING THROUGH OCEAN CABLES.

THE peculiar conditions which are met with in the transmission of electricity through long submarine lines render it necessary to employ apparatus and methods for telegraphic correspondence which differ very materially from those used for land lines. The general principle, however, is that of the single needle telegraph of Cooke. In order to avoid any possibility of injury to the insulating coating of the cable, it is an essential condition that none but very weak currents should be employed, and for this reason the ordinary receiving instruments, which for the most part depend upon the action of electro-magnets, and require currents of considerable force to actuate them, are not available. It would occupy too much space to refer in detail to all the reasons which render it necessary to employ on long cables like those which have been laid across the Atlantic Ocean between Europe and America, the sensitive reflecting galvanometer of Thomson, but it is proposed in this article to describe the arrangement of the apparatus at the stations by which the effects of the phenomena of induction are overcome and the speed of signalling increased to the greatest practicable extent.

In Fig. 1 the manner in which the different parts of the apparatus are arranged at Valentia, Ireland, and Newfoundland, for operating the Atlantic cables, is shown in the form of the diagram. The condenser C consists of alternate sheets of tinfoil and paraffine paper, interleaved, and contains an aggregate inductive surface of 40,000 square feet. It occupies a space three feet long, two feet wide and five inches thick, and is inclosed in a box and surrounded on all sides by a thick body of paraffine. The switch $e\,r\,t$ is a common three point switch, which serves to connect the cable K either with the transmitting keys T or the reflecting galvanometer G (which forms the receiving instrument) when sending or receiving. The double key T, in connection with the battery B, is arranged so that one key, *a*, sends a positive and the other, *b*, a negative current from the battery to line. W is a very large resistance, which connects the end of the cable K to the earth at the point where the former is attached to one side of the condenser C. The battery B usually consists of about five elements of the kind illustrated in Fig. 2.

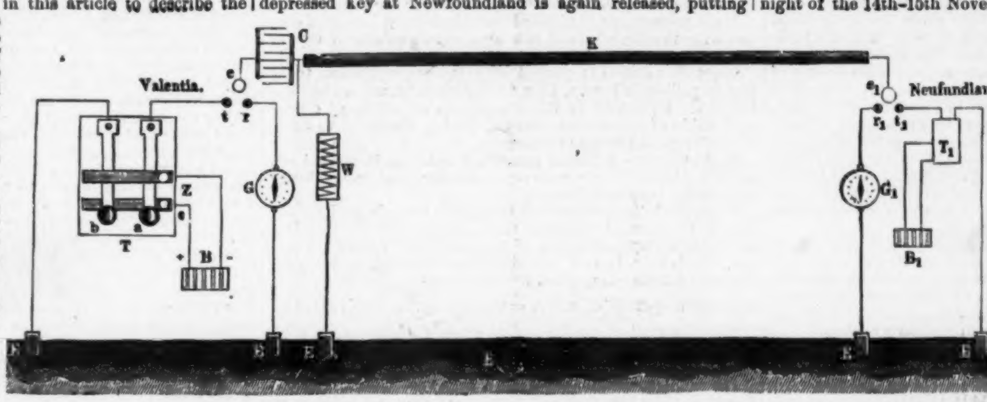


FIG. 1.—THE PRESENT MODE OF TELEGRAPHING THROUGH OCEAN CABLES.

If Valentia wishes to transmit to Newfoundland, the operator shifts the connection of the switch at *e* from *r* to *t*. When the key *a* or *b* is depressed, then one set of plates of the condenser C is charged either with positive or negative electricity, as the case may be. If, for example, the key *a* is depressed, then the + E of the battery flows by way of $c\ a\ t$ and *e* to one set of plates of the condenser; hence the — E of the cable, in connection with the earth at Newfoundland, is attracted, and condensed on the other set of plates, which are connected with the cable, while the + E of the cable is at the same time repelled and driven towards Newfoundland. In this way there arises in the cable a positive current from Valentia towards Newfoundland, passing at the latter station by way of e' and r' to the receiving instrument or galvanometer G′, and thence to the earth, and by the deflection of the spot of light upon the scale produces a + indication. When the key *a* remains depressed but for a moment the flow of current through the cable is of short duration, for as soon as the key is released and touches the bar *s*, not only does the process of charging the condenser terminate, but its discharge as well as that of the cable itself immediately commences. The + E of one side of the condenser immediately begins to flow to earth by way of $e\ t\ a\ s$ and *b*. This sets free the — E of the opposite side of the condenser, which flows off through the cable to Newfoundland. On the other hand, the + E still present in the cable, not having had time to escape to the earth at Newfoundland through the galvanometer G′, flows in the direction of Valentia, where the cable is in connection with the earth through the very large resistance W. Therefore there will be, under these circumstances, two simultaneous currents in the cable of about equal strength, but of opposite polarity or direction, which reciprocally neutralize each other, and thus destroy the inductive action which the original positive current had set up in the outer coating of the cable. By this means the cable becomes completely discharged.

FIG. 2.

By making use of a similarly arranged condenser in Newfoundland, a communication may, in the same manner, be forwarded in the opposite direction; though it is stated that the Atlantic Telegraph Company, in order to avoid Varley's patent, have not adopted the system devised by him, but operate the cable by the use of a single condenser C at Valentia, which answers for transmission in both directions. With a single condenser the signals are sent from Newfoundland in the following manner:

When a key is depressed at T′, then the electricity, for example the + E, flows directly into the cable K, and arriving at Valentia, flows almost entirely into the side of the condenser C, which is attached to the cable, the resistance of W being so great that comparatively little of it goes to the earth. The accumulation of + E in one side of the condenser causes a like quantity of + E to be driven out of the opposite side of the condenser, passing through *e r* and G to the earth, giving a + signal upon the galvanometer. When the depressed key at Newfoundland is again released, putting the cable at that place to earth, then the + E stored up in the condenser flows back into the cable, producing a + current towards Newfoundland, which lasts for a certain time, partly because the discharge of the condenser is not instantaneous, and partly on account of the inductive action set up by the original current. At the same time the — E from the opposite side of the condenser flows through the galvanometer G to the earth, and produces a — signal. In consequence, however, of the great distance between the condenser and the battery, and the short time during which the keys are depressed in transmitting signals, the potential of the charge of the condenser is only about one per cent of that of the battery itself. For this reason the — E which flows from the opposite side of the condenser through the galvanometer to the earth produces a very weak pulsation, which has but little effect upon the needle other than to make it return more quickly to its position of rest, and does not in any way interfere with the regular signals.

It will be seen, therefore, that in this method of working the cable by means of a single condenser, the depression of the positive key at either terminal station produces exactly the same result—namely, the deflection of the needle towards the + side, and in like manner the depression of the negative key at either station gives a — signal. The combination of these two signs, so as to form letters and words, according to the Morse code, is precisely the same as in the single needle instruments, which the cable instruments in fact are.

The insertion of the shunt W, having a very high resistance, which may be considered almost infinitely large in comparison with that of the conductor of the cable, gives rise to only a small loss of current, while it keeps the cable in constant connection with the earth—a result in many respects advantageous. The advantages gained by working with condensers instead of a direct current from the battery, may be briefly stated as follows: The direct current can only affect the galvanometer by first charging the entire cable, while the flow of electricity from the condenser through the galvanometer to the earth commences at the same instant as the charging. When, therefore, the key is depressed, the indication upon the galvanometer follows much more quickly with the condenser than it would with a direct battery current. In addition to this, the period of deflection only lasts during the time of charging, for the moment the potential of the condenser equals that of the pole of the charging battery, the needle immediately returns to zero, even if the key remains depressed. The practical advantage of the method of working with condensers is so great, that a speed of from twelve to eighteen words per minute is reached on the cables between Valentia and Newfoundland.

LA COUR'S "MUSICAL" TELEGRAPH.

HAVING already given a description of the telephone, or musical telegraph, invented by Elisha Gray, of Chicago, Ill. (SUPPLEMENT No. 8), our readers may be interested in the somewhat similar system invented by M. Paul La Cour, the sub-director of the Copenhagen Meteorological Institution. The following is from the *Telegraphic Journal*: "In the electric telegraph, up to the present time, but two simple signals have been employed, and these have been formed either by currents in opposite directions, or by the prolongation, to a greater or lesser extent, of the duration of the current. The system which I devised on the 10th May last enables, however, a large number of simple signals to be made with a single conducting wire.

"When a vibrating body, at each of its vibrations, is made to close and open an electric circuit, the pulsations of the current will, of course, be isochronous with the vibrations of the sonorous body; and when such currents are, by means of electro-magnets, made to act upon a second sonorous body vibrating in unison with the first, the second body will vibrate, whilst another similar body giving a different sound will remain silent.

"The first experiment was successfully made on the 5th June, 1874, but it was feared that the vibrations might cease to be perceptible after traversing a long distance. I therefore made an experiment upon a telegraph line 390 kilometres in length (from Copenhagen to Frederica and back), and, even with a rather weak current, the pulsations were easily perceptible. This experiment was made during the night of the 14th–15th November in the same year.

"To produce the intermittent currents and receive them at the further end, the sonorous bodies employed were tuning-forks. The apparatus is constructed in the following manner: The key or instrument which produces the intermittent current in the line is shown in Fig. 1.

"S S is a tuning-fork fixed by the shank in such a way that at each oscillation one of the prongs touches the contact, *c*, during a portion of the oscillation. The contact, *c*, can be adjusted by the screw, *k*, and, together with its support, is insulated from the tuning-fork by the insulating piece, J.

"When the shank of the tuning-fork is connected to one of the poles of a voltaic battery whose other pole is to earth, and when the contact piece is connected with the telegraph line and thence to earth, a blow given to one of the prongs of the fork will cause an intermittent current to be sent into the line, the pulsation of the current being in unison with those of the fork.

"It follows that, by keeping the fork in vibration, the same result will be obtained whenever the circuit is closed at any given point. It always follows that, by employing a contact upon the inside of the fork with a special battery for the same, the line can be charged with a succession of currents in opposite directions.

"The receiving apparatus is shown in Fig. 2, where P is a tuning-fork of soft iron, giving the same sound as that of the key. The prongs are inserted lengthwise in the coils, T T, which are surrounded by silk-covered copper wire; the prongs are so arranged as to vibrate freely within the centres of the coils. The intermittent current, on arriving at the station, passes through these two coils, and thence into the wire of an electro-magnet, M M, which is arranged so that its poles are placed in front of the opposed poles produced in the fork. It is evident that the current, in magnetizing the electro-magnet and the fork, produces an attraction which will open the prongs of the latter, but directly the current d, consequently, the attraction ceases to operate, the prongs will return to their position of equilibrium, and so on.

FIG. 1

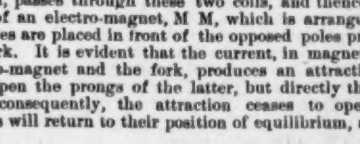
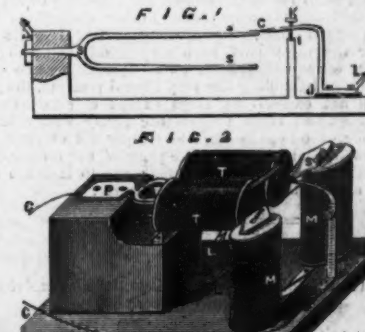


FIG. 2



LA COUR'S MUSICAL TELEGRAPH.

If then the pulsations of the current are in unison with those of the fork, the vibrations of the latter will soon attain a sufficient extent for one of the prongs, *n*, to touch the contact piece, D, closing the circuit, C C, of a local battery, and thereby manifesting the arrival of the current in the usual way, either directly or by means of a relay.

"I can not as yet, I admit, state the time required to produce in the fork of the receiving apparatus vibrations of a certain extent; it is a function of various factors, but experiment shows that the time which elapses before the local circuit is closed is so small a fraction of a second as to be hardly perceptible, even when the current is very weak. In the hope that this

system will play an important part in electric telegraphy, I beg to here point out its principal advantage.

"The intermittent current acts upon that tuning-fork only which is in union with the fork of the key. If, then, any number of different keys are arranged, and the same number of receivers to correspond, an equal number of simple signals can be produced, each of which requires but a single movement. If each of these signals corresponds to a letter, figure, or other sign, messages may be sent more quickly than by present methods, and the receivers can be made to act upon a printing apparatus without any difficulty.

"The same peculiarity will admit of the employment of these signals where several stations are connected together by a single cable. A signal can be sent between any two of the stations without the others being aware of it. The system might also become applicable in various other circumstances; for example, to call, give warning, announce the occurrence of an accident, fire, torpedoes, etc.—in a word, in all cases where it is desired to transmit signals only to certain points.

"Another important property of the system is, that several signals can be produced *simultaneously* upon the same wire. For when several keys are acted upon at the same time, the current thus produced, with simultaneous intermissions of different duration, will only act upon the receivers corresponding to the vibrating keys, if only the forks have been selected in such a way as to avoid simple harmonies between them. Thus, for example, by employing a system of ten tuning-forks, ten simple signals can be produced, then $\frac{10 \times 9}{1 \times 2} = 45$ signals when combined two and two, without the latter requiring more time than the simple signals. The question of the limit to the number of forks which can be vibrating at the same time, is one that can only be determined by experiment.

"The same property makes it possible to transmit several messages to various stations, employing but one wire. For example, station A is connected by a wire with station B, whence the wire is continued to station C. Station A can use two different systems of keys, one for station B and the other for station C. The receivers at the two stations must, of course, correspond with the keys. The same property also enables the system to be employed for pantelegraphs of a more reliable and quicker form than those made by Bain, Caselli, and others. Up to the present time only one style has been used in such telegraphs, and this style has to pass over the whole surface of the telegram to produce a copy of it; in the new system, however, as many styles as may be desired can be placed side by side in the form of a comb, which will then pass over the surface of the message in one direction only. By this method, also, there is the advantage that exactly equal speed is not required in the two instruments, for the only inconvenience which would result from a difference of speed between the original and the copy would be a slight contraction or extension in width of the whole message.

"Lastly, the receivers have the valuable peculiarity of letting ordinary electric currents pass through them without any indication of their presence—at least unless the currents are of very considerable intensity, so that atmospheric and terrestrial currents would not, as a rule, interfere with the working of telegraphs arranged upon this new system."

PRUNES AS CHEAP FOOD.

The consumption of prunes in this country has very much increased of late years, not only among our foreign-born citizens who acquired their fondness for this fruit at home, but also among native Americans, who are now largely using prunes in preference to domestic dried fruits. They have the advantage of being relatively much cheaper than any of our native dried fruits, and there are none of the latter that are more wholesome or can be served more palatably. Our imports of Turkish prunes come from Servia, Bosnia and Trieste, the fruit from the two former now coming mixed. These prunes come in casks weighing from 1300 to 1400 lbs., and we have received thus far in the trade year, beginning September 1st, 1875, about 16,000 casks, equal to 21,000,000 lbs., while our total receipts during the whole of last year were only 8906 casks, or about 12,000,000 lbs. Turkish prunes sell very largely at the West, their chief consumers being the foreign settlers to whom their cheapness is an important consideration. French prunes generally are of much better quality than Turkish, and sell considerably higher. They are consumed chiefly at the East. French prunes come in kegs and cases, the latter containing from 30 to 60 lbs. each, the average being about 50 lbs. We have received since September 1st, 128,000 cases of these goods, and our imports for the year will probably reach 140,000 cases. The large prunes, running 40 to 45 to the pound, are the most desirable, but the sizes from 50 to 85 are all staple. Smaller prunes, ranging from 90 to 105 to the pound, are generally of inferior quality, as they include windfalls and other unmatured fruit—and their sale is small. The quality of our imports this year has for the most part been very good, and the consumption has never before been on so liberal a scale or so general. Notwithstanding the very liberal receipts, the present stock is not excessively large except of small French fruit. Turkish and large French are pretty well sold up, though enough are held in stock to supply all current running requirements, and to keep the price of the former down to an unusually low point, which must serve to increase their popularity as an article of food.—*The Grocer.*

A NEW COLOR THERMOSCOPE.

(Translated from *Mittheilungen über Gegenstände des Artillerie- und Genie-Wesens.*)

In an article in the *Scientific American* a short time ago, mention was made of a red substance which might be obtained by the precipitation of potassium quicksilver iodide in solution, by means of a similar solution of cupric sulphate (blue vitriol). This body when heated beyond a certain temperature would take a chocolate-brown color, but upon being cooled again, its original color of red returned without the body having undergone any change in its chemical constituency.

As the substance is but indefinitely if at all described in chemical literature, and as it may be made of use in certain technical ways, I have interested myself in the study of its origin and qualities, and also in its utility.

If a solution of iodide of mercury and iodide of potassium be first prepared in accordance with the formula KI Hg. I_2, and a mixture is made of it and a solution of cupric sulphate, a precipitate will be formed having a vermilion color, whilst iodine will be set free. This precipitate is freed from the fluid by decanting with a weakened solution of hyposulphite of sodium, and it is then washed in distilled water until no iodine is apparent. Finally it is collected on a filter and dried in a desiccator over sulphuric acid.

The precipitate shows a tendency to become brown, but by examination under a microscope it is seen to be still impregnated with iodide of mercury. It is not possible to completely separate the iodide of mercury from this body, either by treatment with iodide of potassium or even washing with alcohol, without changing its constitution.

If in the preparation of the potassium quicksilver iodide an excess of iodide of potassium is used, the body will be rendered free of iodide of mercury; if, however, a large amount of cupric sulphate be used, it will be mixed with "iodure" of copper. Fortunately the precipitate proves to be soluble in boiling muriatic acid, and it may thus be crystallized. The preparation, after being washed in distilled water and dried in the desiccator, shows by analysis the following composition by weight:

	I.	II.
Cn.	10.0	10.4
Hg.	29.8	30.4
I.	59.5	59.7
	99.3	100.5

This composition of the body then (disregarding impurities which could not be removed by crystallization) corresponds with the empirical formula Cn. Hg. I_3, from which the following composition by percentage is obtained:

	Calculated.	*Found (Mean).*
Cn.	9.9	10.2
Hg.	31.0	30.2
I.	59.1	59.6

The color of the crystallized substance is madder red; the crystals, however, on being rubbed, turn to bright red; at 70° Cent. and above, to chocolate brown, and by cooling to below 80° Cent. it resumes its original color. The composition and qualities of the body are not changed at 100° C. At 150° C. iodide of mercury escapes, and it is wholly driven out by a higher temperature when iodine vapors are formed.

If the preparation is highly heated in a glass jar out of contact with the air, a part of the copper as sub-oxide of copper affects the glass (making it ruby-glass).

If potash solution is poured over it, the preparation turns first to yellowish brown, then to blueish gray, and on heating to black. Evidently in these reactions, sub-oxide of copper with oxide of mercury are shown, quickly changing to oxide of copper and sub-oxide of mercury.

If the alkaline iodide of potassium solution is poured off, and the black mixture is covered with muriatic acid, chloride of mercury is at once formed.

From the before-mentioned empirical formula and the observed reactions, I conclude that the new preparation is a double compound of iodide of mercury and "*iodure*" of copper, $Cn_2\ I_2\ 2Hg.\ I_2$, and I consider the following as the most condensed form of equation for the reaction:

$$2KI\ Hg.\ I_2 + 2KI + 2Cn.\ SO_4 = Cn_2\ I_2\ 2Hg.\ I_2 + 2K_2\ SO_4 + 2I.$$

The preparation can be spread upon a surface as a color coating by means of alcoholic shellac varnish as shown in the sample.

If a pigment of this sort be spread upon a chemically indifferent surface (water-glass, paper, porcelain, etc.) it may be used as a color thermoscope in any place where it is desired to ascertain a temperature between 70° and 100° C., at which point it immediately changes color.

In all parts of machinery where there is great friction, and where ordinary thermometers can not well be applied, or which are difficult of access, this will evidently be of great service as an indicator of overheating.

In such machines, as well as in heating apparatus of all kinds, a point must always be found which it is necessary to keep below a temperature of 70°. If overheating does occur it is immediately made known by the change of color of the thermoscope. In certain places where shielded thermoscopes are necessarily applied, this is of the greatest service, such as axles of railway or other trucks, cylinder-heads, etc.

Since the sensitive color must always be applied in a measurable thickness, it is clear that by the heating from the under surface out, the lowest surface becomes brown first, and by observation of the thermoscope a certain allowance may be made.

In order to assist the judgment it would be well to paint on either side of the thermoscope colored fields, one of which should be of the normal color, the other of the brown shade.

Filipp Hess,

Captain in the Corps de Genie, Imperial Austrian Artillery Service.

ELEVENTH ANNUAL MEETING OF THE AMERICAN SOCIAL SCIENCE ASSOCIATION.

School Hygiene—Paper by Dr. D. F. Lincoln, of Boston.

So much has already been written and spoken of late upon subjects connected with the health of schools, that it seems desirable from time to time to sum up the results of this activity and present them briefly to a public which, though eager for information, has not the time to follow the course of special inquiries. Such a summary will be presented in this paper; and at the close certain points will be indicated which seem to the writer to call for direct action from responsible parties.

The school-house itself has been a point of persistent attack from reformers for many years past, and, in fact, we find that in the building of the house many mistakes are usually committed, and many desiderata are usually missed by the planners. These we will now proceed to consider.

The choice of a site is a matter of serious importance. It is absolutely necessary that the ground should be so situated and the soil of such a character, that thorough drainage can be effected. We all know from experience the discomfort of inhaling the excessively *dry* air of furnaces during the winter; we are enlightened by our sensations in regard to the necessity of providing artificial evaporation of water in our houses; but we readily forget how damage may come from the opposite quality of *excess of moisture*, and we stare in surprise at statements like those of General Viele, who says that water in the soil, in spots inhabited by man, is the greatest of all foes to his life and health. Nevertheless, this is the simple truth. In choosing the site, therefore, it is necessary to avoid places where subterraneous water-courses exist, or where there are springs or a natural basin for receiving water-shed from higher ground. All these conditions, and more, may exist in large cities as well as in the country; I may add that they do frequently exist, and are known to add largely to the mortality. In towns built upon tide-water, like our own, there is the additional danger arising from low-level fillings, where drainage of the soil is next to impossible.

A site may be bad for certain other reasons. In a narrow street with lofty houses the light is very deficient; and if a school is built in such a place, there is a tolerable certainty that the scholars will show a large proportion of near-sightedness and other defects of vision. In this respect the planting of trees of dense foliage near the house has its disadvantages, besides being injurious through the excess of damp which they engender.

And, finally, any site is bad which does not allow a reasonable space for a play-ground or gymnasium.

If there be any science of which it is true that "a little knowledge is a dangerous thing," surely that science is architecture. For not to speak of the dangers to life and limb entailed by careless masonry or carpentry, there is a broad and radical perversity of thought pervading the minds of architects leading them to a preference of *form* before *use*. External effect is admirably attained in many of our public buildings; but as a rule it may be said of their interior arrangements that they undermine the health of those who are obliged to spend time in them. They are grand, symmetrical, elegant to look at, but within they are hot-beds of consumption, lung fever, neuralgia, headache, and other ills. I do not speak of our public schools alone, by any means, but include our libraries and halls of administration in this statement. And more: they are unhealthy simply from want of forethought and knowledge on the part of their builders; they are specimens of ill-adaptation in every respect, some of them no better suited even to the primary purposes of work for which they were built than they are for thorough ventilation. In these statements I do by no means intend to characterize the whole profession of architects as negligent; the blame lies very much with us, the public, who do not care enough for health to make it worth while for architects to attend to its requirements.

In inspecting school-houses that are called models of their class and examples of good construction, one is generally struck with some defect, so obvious that it stares one in the face as soon as it is pointed out. For example: In one very large school built within ten years, the ventilation of certain rooms is notoriously horrible; the large hall for assembly is ventilated upwards into the attic, and the outlet into the attic is closed up; while the windows are not opened between schools to air the rooms, perhaps on account of the expense involved in reheating the air of the house. In a fine new school in New-Haven, in the month of May last, I found the janitor sweeping—it being after school hours—with the windows shut; and I was told that it was "his way" to shut windows when he swept. In a model school at Hartford I found that the ventilation depended upon the suction which the breeze passing over the roof might casually exercise upon the air-flues which discharged there; a reliance upon which, I scarcely need say, was entirely futile, as was proved to my own senses by the close, foul air of the building. In a school of excellent character and recent construction at Detroit I was shown into a room full of pupils intent on a written examination, sitting in an atmosphere at 82 degrees, which was indicated by a thermometer hanging by the teacher's desk. A new model school in Philadelphia, which has cost its devisers much thought, is planted directly in the shadow of one of the largest buildings in the city; for its side wall and windows stand within ten or twelve feet of the rear wall of the Academy of Music. The office of the Board of Health in this city is not ventilated except casually by doors opening into underground corridors, or by windows which are also half-under-ground; and its steam-heated air easily attains a temperature of 77 degrees. The case might be made much stronger, but you will doubtless dispense with further illustrations.

In the present confusion of ideas, and the almost despair of good sanitary results in architecture, which holds the public mind, it is well to be able to point to certain results which prove how much can really be accomplished by intelligent foresight combined with judicious caution as regards the price to be paid for our whistle. As an example of perfect construction and adaptation to use, let me point to the new Sheffield scientific school building in New-Haven, which was built with reference to the requirements of exactly those who were to occupy it—draughtsmen, microscopists, laboratory-workers, attendants upon general or special lectures, and so forth; which satisfied the requirements of all the professors, both before it was built and after, and which, planned to cost a hundred thousand dollars, was handsomely and thoroughly executed for within a few hundred dollars of this sum. In this city there are two private school-houses which illustrate very well General Morin's system of downward ventilation, and extraction of air by a vacuum; the rooms thus ventilated are sweet and fresh without opening windows, which can not be said of one school in five hundred. And, to give credit where credit is due, the Board of Health of this city is now experimenting in the direction of ventilation for schools, with great judgment, and with a good prospect of improvement.

Let me now enumerate very briefly some of the faults often committed in building schools.

Thorough lighting of the rooms is greatly assisted by making the heads of the windows square and bringing them close to the ceiling; round or pointed heads to windows, on the contrary, intercept a great deal of light, and so do buttresses and colonnades. As previously stated, there ought to be a considerable space all around the school; and it would be worth while if our architects would take into consideration the German fashion of building around a court-yard, which certainly has something to recommend it from this point of view. I may add a suggestion of Frederick Law Olmsted's, as to the way a house ought to face. He justly remarks that if it faces to the four cardinal points of the compass it is set in the worst position possible, as regards any advantage to be derived from the rays of the sun, while if made to point north, south, east, and west with its *corners*, its four *sides* will all receive a share of the sun's rays, even in the winter.

To provide against the danger of a panic, in case of fire, the main entrances and the stairways should be reasonably wide and numerous. Stairs ought not to be long or steep: their rails should be tolerably high, and there should be no well.

The artistic excellence of a design should always be a subordinate point, as compared with internal excellencies. The Gothic style, if that be made to include pointed windows, is absolutely objectionable; and if it or any other style implies high turrets or lofty attic stories which can not be utilized for school-work, it may be necessary to abandon it upon economical grounds. I can not too greatly commend the good sense which has led the authorities at the City Hall to reject certain noble and beautiful plans for the new public high and Latin school, in favor of certain others, also beautiful, but

more modest and economical; for it can not be doubted that there are more important things than noble architecture. Coal to burn, to make the ventilation perfect, and land for the children to play upon, are in my mind of more importance than external magnificence of form; and the light which is thrown back from glittering pinnacles and roofs is of little value compared with the plain white rays which strike in and light up the page of the scholar.

In the sanitary arrangements of the interior of a school there is vast room for going wrong. Yards and cellars may be subject to overflow, and the drains may get out of order from time to time, or may be unprovided with traps to keep sewer-gases out of the house. Water-closets may be too few or badly trapped, or their lead pipes may leak; privies may be placed so that children must inevitably get wet feet in visiting them in rainy weather. Furnaces may leak gas or be unprovided with evaporators; ventilators may break or get stuffed up, or may, through absence of mind on the part of the builders, be unprovided with external outlets; or the outlet may be (and usually is) vastly too small; or there may be no motive force provided to propel the air through them. The drinking-water is sometimes polluted so as to cause epidemics of serious disease in the children.

With these brief remarks upon the principles of construction, let me now pass to a still briefer review of some of the details of injury to health caused by neglect of these laws.

Certain diseases of the eye, certain deformities of the spine, and a certain enfeeblement of the nervous system and digestion are known to physicians as caused by bad arrangements of light, heating, ventilation, and school-desks. The harm done to growing girls from twelve to eighteen years of age has been fully discussed within a year or two. Of the extreme value of gymnastics as a preventive of school-debility little need be said; they are the very best thing we can do for the children at present, and it is with great pleasure that I note the success of the effort to introduce them in some of the Boston schools.

Physicians are accused of looking at the wrong side of the pattern of things, and of inferring the physical degradation and weakness of a community from those individuals who come to them for relief. Now, I am not going to deny that there is such a tendency, but I will ask you for just a moment to consider what the general tendency of people of the world is; whether there is not, on the whole, enough indifference to health on the part of the public to make up for what over-anxiety the doctors may feel. To a well and strong man, the world seems well and strong. Life puts on its cheerful face to the cheerful eye, and the man who has no nerves is not apt to notice that others have them. You know the story of the judge, who remarked, apropos of ventilation, that he had heard a good deal about good air and bad air, but for his own part he knew of only two kinds, one *warm*, the other *cold*. I think there are enough people of this sort, gifted with a happy insensibility to poisons and other bad things, to make up for the over-anxiety, if such it is, which physicians are believed to manifest in regard to public health.

It appears to me that, in planning measures for the relief of existing ills in school life, our first duty is not to the children alone, but equally to the teachers. They are quite as liable to suffer from excess of nervous strain. They are mostly women, with woman's infirmities, among which must be included as a factor of exhaustion their willingness to help others who depend on them, their habit of doing whatever is left undone by others, and the habit of mind which carries its school-work home, and never finds its work *all done*. The teachers ought to be made to practice gymnastics for their own defence against illness, unless they are evidently taking enough exercise in other ways, as in walking. No class of persons in the State are more in need of protection from voluntary overwork and neglect of recreation of body and mind.

In the second place, having provided for gymnastics, it will be well for us to see that some very practical instruction, dogmatic rather than scientific, is given in the principles of hygiene. A set of rules can be taught and enforced. But as to the science of physiology, it seems to me of questionable value for schools, chiefly because it must be taught so superficially, and as so taught, must tend to foster the American fault of universal conceit of knowledge. And yet for intelligent and advanced pupils, no study is more engrossing, more full of wonder, more capable of training logical perceptions. I venture no opinion as to its value in a normal-school course.

In the third place, regulations must be introduced to prevent the spread of contagious diseases among school-children. At present, in this neighborhood, the parents of children who have scarlet fever or small-pox may send them back to school just as soon as they think fit, to the terror of other parents and the detriment of the school from the panic which such irresponsible carelessness excites. It is not my intention to offer at present any plan for correcting this; but it certainly ought to be corrected by the school committees and the boards of health.

This brings us to a fourth point—How shall we place the sanitary care of schools under proper control? And who shall exercise such control? Medical authority and that of scientific engineers are equally needed in this matter. In Germany it is universally recognized as a principle that no school, not even a private one, can be kept up without the certificate of the proper sanitary officers as to its wholesomeness. I wish to call your attention, by way of illustration, to an investigation made recently in England by the Lancet Sanitary Commission, a voluntary organization, which has made the tour of the great public schools at Winchester, Harrow, Rugby, Eton, Marlborough, and elsewhere, and published the results of their inspection in the *Lancet* of June 5th and 19th, 1875. There is not time for an abstract of their results, but a list of the particulars inquired into will be interesting:

"1. The relation of the school to the town, the drainage, water-supply, and the constitution of the sanitary authority.

"2. The means adopted to prevent the introduction of zymotic diseases.

"3. The means employed to prevent the spread of epidemics and to secure the isolation of cases.

"4. The general sanitary arrangement of studies, dormitories, lavatories, closets, urinals, etc.

"5. The supervision, medical or otherwise, exercised over the boys with respect to their capacity for medical or physical exertion."

All these points are such as require attention and supervision from above in every school. Local knowledge and the discretion of individual masters (or janitors, as the case may be) are not to be trusted.

Dr. Winsor, in the fifth annual report of the Massachusetts Board of Health, expresses his conviction that every child going to school ought to be seen once a month by some medical man, a member of the town Board of Health; and that in every city there should be a sanitary inspector and instructor of schools who should be a physician.

This subject was reported upon and fully discussed in the general meeting of the Association held last May at Detroit.

It may not be well to include private schools under such a statute, but it is desirable that they shall be permitted to place themselves under control if they desire it. Certainly they need control; if not that of law, at least that of example.

Finally, ladies and gentlemen, there is a way in which many of you may begin to work without waiting for the enactment of any statute. You may obtain permission to institute sanitary inspection of any school district you are interested in, as has been done of late in several ways. I would point to the work recently accomplished under the orders of the Philadelphia School Board, as a model of what such work should be in respect to thoroughness and intelligence. All of their public schools have been examined within the year, in respect to the main points I have brought up, and the results published in a pamphlet containing a large number of interesting tables. Such extensive work has not been done elsewhere, to my knowledge, upon this continent. But within a few months, in this city, we have seen some excellent work done in the same direction by Drs. Draper and Nichols, who have instituted examinations of the air in ten of our own public schools, which have been published in the report of our city Board of Health.

With these few suggestions, which I hope will be found sufficiently practical in tendency, I take leave to lay the subject before your private consideration.

SOUND.

ROYAL SOCIETY. LONDON, JANUARY 6.

ON the refraction of sound by the atmosphere, by Prof. Osborne Reynolds, Owens College, Manchester. Communicated by Prof. Stokes, Sec. R.S.

This paper may be said to consist of two divisions. The first contains an account of some experiments and observations undertaken with a view to ascertain how far the refraction of sound caused by the upward variation of temperature may be the cause of the difference in the distances to which sounds of the same intensity may be heard at different times.

Some rockets, capable of rising 1000 feet and then exploding a cartridge containing 12 oz. of powder, having been procured, an effort was made to compare the distance at which the rockets could be heard with that at which a gun, firing ½ lb. of powder and making a louder report than the rockets, could be heard under the same conditions of the atmosphere. In the first instance the rockets and the gun were fired from a spot in Suffolk, around which the country is tolerably flat, observers being stationed at different distances. Owing, however, to the effect of the wind and the time required for the observers to proceed to the distant stations, these experiments were not successful in establishing the comparative merits of the gun and the rockets. They were, however, important as showing that on hot calm days in July the reports of the rockets never failed to be distinctly audible at distances of four and five miles, although the sun at the time was shining with full force on the ground, and rendering the air near the surface so heterogeneous that distant objects seen through it appeared to wave about and twinkle.

The next attempt was made during a cruise on the east coast. After three weeks' cold and windy weather, the 19th of August was a fine day, and some experiments were made in Lynn Deeps, which revealed a very extraordinary state of the atmosphere as regards the transmission of sound. A party rowed away from the yacht in one of her boats, it having been arranged beforehand that either a rocket or a large pistol was to be fired from the yacht when signalled for; also that when those on the yacht heard those in the boat call they should answer. The boat proceeded to a distance of five miles, until those on the yacht had completely lost sight of it; but all the time the calls from the boat were distinctly heard by those on the yacht, although after they had lost sight of the boat they ceased to answer the calls. On the boat also not only were the reports of the pistol and rockets distinctly heard, but every answer from the yacht was heard plainly. The last came after an interval of thirty-five seconds, which gave the distance 3½ miles. Nor was this all; but guns, and on one occasion the barking of a dog, on the shore eight mile distant, were distictly heard, as were also the paddles of the steamer fifteen miles distant.

The day was perfectly calm, there was no wind, the sky was quite clear, and the sun shining with great power—conditions which have been described as most favorable to the stoppage of the sound by the heterogeneity of the atmosphere, and which may also be described as most favorable for great upward refraction. On this day, however, it was observed that all the time distant objects *loomed* considerably, *i. e.*, appeared lifted. This showed that the air was colder near the surface of the sea than it was above. It is to this circumstance that the extraordinary distances to which sounds were heard on this day is supposed to be due. The diminution in the temperature of the air being downwards, the sound, instead of being lifted as it usually is, was brought down, and thus intensified at the surface of the water, which being perfectly smooth, was thus converted into a sort of whispering-gallery.

The report of the pistol and the sounds of the voice were attended with echoes, but not so the reports of the rockets; and it is suggested that these so-called echoes may be found only to attend sounds having greater intensity in one direction than in another.

The second part of the paper refers to a phenomenon noticed by Arago in his report of the celebrated experiments on the velocity of sound made on the nights of the 21st and 22d of June, 1822.

It was then found that, although the guns fired at Montlhery could be distinctly heard at Villejuif (eleven miles distant), those fired at Villejuif could not be heard at Montlhery without great attention, and at times (particularly on the second night) they were not heard at all; although on both nights the wind was blowing from Villejuif to Montlhery, the speed of the wind, which was very light, being about 1 foot per second. No explanation of this phenomenon was offered by the observers, although it was much commented on. And on the second night the gun at Villejuif, which on the previous night had been pointed upward, was brought down in the hope that this might improve its audibility (this step was, however, found to render matters worse than before).

From this lowering of the gun at Villejuif, it seemed as though there was probably some difference in the conditions under which the guns at the two stations were placed, as if that at Villejuif was fired from a level, while that at Montlhery might be fired over a parapet. An inspection of the district confirmed this view; for Villejuif is on a low, flat hill, while Montlhery is on the top of a steep cone; and not only is it 80 feet above Villejuif, but it is surmounted by the mound of an old castle, which is supported by a vertical wall towards Villejuif and surrounded by a low rampart. Hence it is suggested that in all probability the advantage of the gun at Montlhery was due to its being fired over this parapet, while that at Villejuif was fired from the level ground.

The fact that the wind blowing from Villejuif did not reverse this advantage, suggested the possibility that at night, when the diminution of temperature is downward, a light wind may not produce the same effect upon sound as when the diminution of temperature is upward, as it generally is during the day.

To ascertain if this is the case, some observations were made on some calm nights in May and June of the present year, from which it was found:

(1) That the sky was cloudy and there was no dew. The sound of an electric bell 1 foot above the grass could always be heard further with the wind than against it; but

(2) That when the sky was clear and there was a heavy dew, the sound could invariably be heard as far against a light wind as with it, and in some cases much further. On one occasion, when the temperature at 1 foot above the grass was 38° and at 8 feet 47°, and the speed of the wind was 1 foot per second at 5 feet above the grass, the bell was heard 440 yards against the wind and only 270 with it.

Since, therefore, on the nights of the experiments at Villejuif and Montlhery it is stated that the sky was clear, that there was dew, and the temperature recorded at the two stations shows the diminution to have been downwards, it is argued that the effect of the wind to render the sound less audible at Villejuif was completely balanced by the downward refraction of temperature.

Another phenomenon recorded by Arago is, that while the reports of the guns at Montlhery as heard at that station were attended with prolonged echoes, this was not the case with those at Villejuif. It is thought that this difference is sufficiently accounted for by the fact that while Montlhery is surrounded by high hills with precipitous or wooded sides, which must produce echoes, the country in front of Villejuif is very flat and has not a tree upon it for miles.

In concluding the paper, reference is made to the Appendix to the last Report of the American Lighthouse Board, in which Dr. Henry, the Chairman, gives an account of his experiments, extending over thirty years, and the conclusions to which they have led him; both of which are in favor of the apparent stoppage of the sound being due to refraction.

WASHED AND UNWASHED EMULSIONS.

AN interesting illustration of the effect exercised by washing emulsions, so as to remove the soluble salts formed by the double decomposition of the nitrate of silver and the bromide salt employed in forming the bromide of silver, is given by Mr. T. C. Roche in a communication to the Photographic Section of the American Institute. A sample of the emulsion which was working well was divided into two portions, to be kept twelve months before further trial. We will, however, allow Mr. Roche to tell the story. He says:

"I divided the emulsion into two equal portions, one half being labelled with date and put away from the light, the other half I washed in the following manner: Taking a deep porcelain dish, half filled with distilled water, in the dark room, I poured the bromide emulsion into it. The emulsion soon clotted up. After stirring it well with a glass rod, draining the water off, and washing again in a few changes of water and draining, I squeezed all the water out, broke up the cotton, and set it away to dry. When dry, I mixed with equal portions of ether and alcohol, so as to give a good, flowing film; after filtering I found it to work quick, clean, and brilliant. This bottle I also put away.

"On my return, after an absence of twelve months, I found the unwashed emulsion on trial to fog a little, and not so sensitive. In the bottle of washed emulsion I found a perfectly clear liquid, with a fine white sediment at the bottom. Shaking it up well, and after allowing the bubbles to subside, I tried a plate and found it had lost none of its original good qualities, and developed free from any kind of fog.

"The addition of a few drops to the ounce of emulsion of an alcoholic solution of hops, boneset, liquorice, or any organic matter soluble in alcohol which is also soluble in water will act as a preservative on the plates, but in a week's time it seems to affect the emulsion in the stock bottle.

"The emulsion was made in the following manner:

Ether	8	ounces
Alcohol	6	"
Bromide ammonia	112	grains
Anthony's sol. cotton No. 1	112	"

"After a good shaking, I added, in two ounces of hot alcohol, 240 grains of nitrate of silver, shaking up well, and the next day I added a quarter ounce of iodide solution (alcohol one ounce, iodide of ammonia fifty grains), shaking well and filtering a little before trying a plate. If it showed any sign of fog, I added a few drops more of the iodide solution. This will bring the emulsion all right. If there is too much iodide in, a fine granular deposit will be seen on the sides of the bottle. A drop or two of silver in alcohol will take this all up."

ANILINE-BLACK, WITH REFERENCE TO THE MEMOIR OF M. COQUILLION.

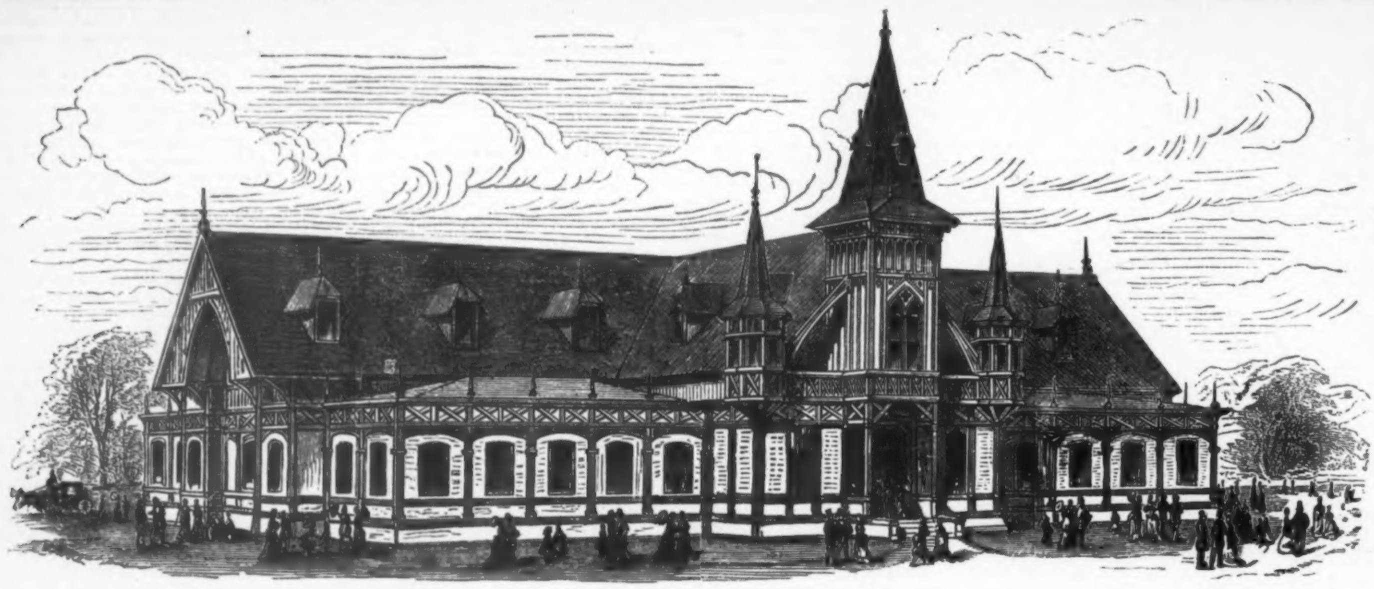
M. A. ROSENSTIEHL.

IN the present state of science, whenever we wish to obtain aniline-black upon any tissue industrially, that is to say, economically and regularly, the simultaneous action of a chlorate and of a metallic substance is indispensable. Practice has selected copper for blacks to be developed at about 350° (?), and iron for those which have to be steamed (100°). If industrial conditions are not required, we may obtain aniline-black upon the tissue by the mere use of active oxygen without either chlorate or a metallic compound. In the same manner aniline-black may be produced without the tissue, and without the intervention of a metal, but with the aid of chlorates. The researches of M. Coquillion show that in this case also the same result may be reached without the chlorates. The fact observed by him is an elegant demonstration of the effect of active oxygen upon the salts of aniline.

ACTION OF OZONE UPON ANIMAL MATTER.

M. A. BOILLOT.

THE author finds that meat may be preserved longer in ozonized air and ozonized oxygen than in ordinary air and oxygen.



THE INTERNATIONAL EXHIBITION OF 1876.—THE PENNSYLVANIA STATE PAVILION.

THE PENNSYLVANIA STATE BUILDINGS.

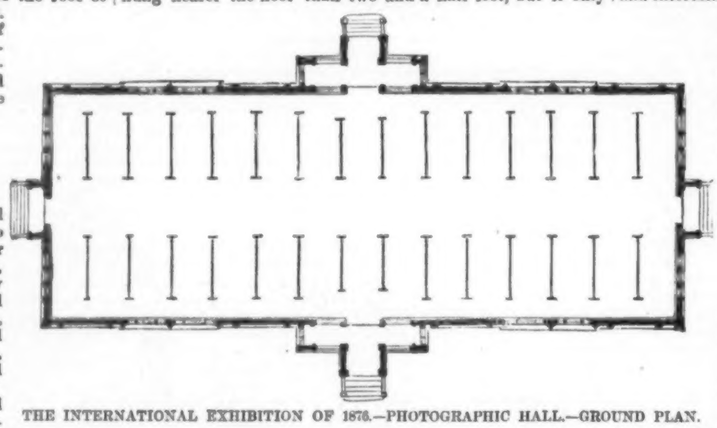
THE Pennsylvania State Building is located on Belmont Avenue, near the United States Government Building. The State appropriated $15,000 for its erection, and it is to be the headquarters of the Pennsylvania State Commission. It is a wooden Gothic building, 98 by 55 feet. It is surrounded by a tasteful piazza, six feet wide, and is ornamented with a central tower, flanked on each side by two smaller octagonal towers. The height to the eaves is 22 feet, to the peak of the roof 39 feet, and to the top of the central tower 65 feet. The main hall is 30 by 50 feet, on the right of which are two rooms 20 by 20 feet each, intended for ladies' and gentlemen's parlors, beautifully fitted up, and having dressing-rooms and other conveniences attached. On the left are two committee-rooms, 20 by 27 feet.

[The Philadelphia Photographer.]

PHOTOGRAPHIC HALL.

WE must not imagine that Photographic Hall is going to be an Aladdin's palace (though to many of us it will be as full of riches as that), for it is to be built of wood, and plaster, and iron, and glass, and bronze, and it is to be beautifully painted, and as the architect's specifications ell us, it is to have piles, and pipes, and sleepers, and trusses, and sheathings, and rafters, and purlins, and plates, and porches, and a lantern, and ribs, and panels, and joists, and ships, and jamb-blocks, and imposts, and plinths, and cappings, and studs, and pilasters, and mitres, and bay-windows, and top-lights, and Louvre ventilators, and cornices, and pediments, and upset eyes, and hexagonal sleeves, and pendants, and bases, and zones, and small ornaments, and carvings, and what-not, just like any other building of beauty, and is to cover a space 258 feet long, east to west, by 107 feet wide, north to south. It will be beautiful in exterior, as the very handsome woodcut presented herewith will prove. The interior arrangement will be as follows:

The hanging screens are twenty-eight in number, four of them are 19 feet long, and twenty-four are 24 feet long each, and as both sides are equally good for an exhibit, and as a band of 10 feet of pictures may be reckoned, it furnishes forty-eight spaces of 240 squarefeet each, and the four screens of 19 feet long each furnish eight spaces of 190 square feet each. The walls of the building furnish 5320 feet more—together, 18,360 square feet. Add to this the surface of the T-shaped termination of the screens towards the middle avenue, and we get 720 square feet more, making a total of 19,080 feet. Now this estimate is based on the assumption that pictures will not be hung nearer the floor than two and a half feet, but if only half of that should be covered (at the option of exhibitors, of course), it would add about 800 square feet more.



THE INTERNATIONAL EXHIBITION OF 1876.—PHOTOGRAPHIC HALL.—GROUND PLAN.

The screens stand 16 feet apart, and in some cases floor space can be gained for exhibits between them, and floor space will be had for the same use all along the middle avenue between the ends of the screens. The T-shaped termination of the screens towards the middle avenue is available for pictures, and will be from two to two and a half feet wide. These ends of the screens being covered with pictures will greatly improve the effect in viewing the middle avenue along its entire length, as in sharp perspective it has the appearance nearly of a continuous wall of pictures. The main purpose of it, however, is to stiffen and strengthen the screens.

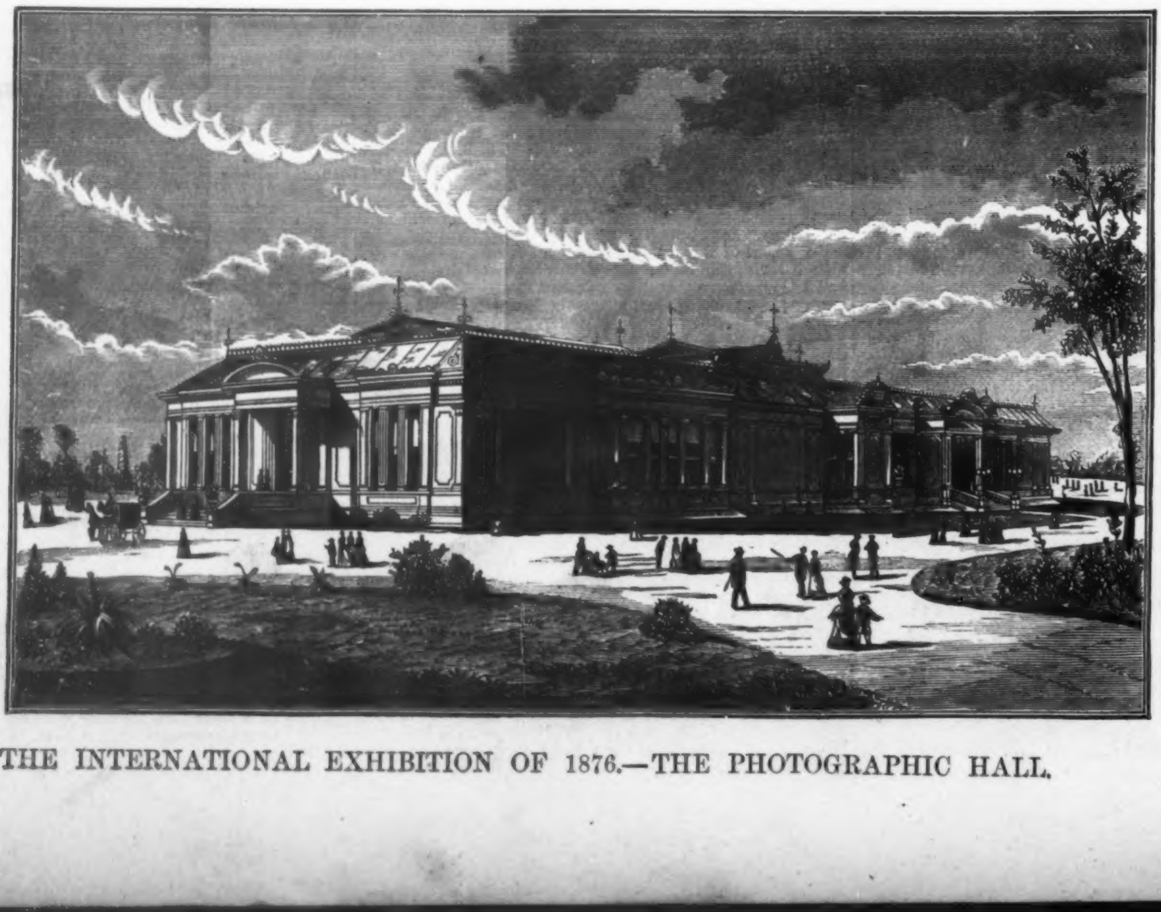
It will be seen from this that there will be an exhibition of photography here, such as the world never saw, if there is more enterprise shown in filling the space allotted than there is in subscribing for the stock to build it. In this matter do your best, or your foreign friends will beat you. You have read Dr. Vogel's statement that there will be a very elegant and interesting collection sent from Germany. It will leave Berlin in February, we believe. Dr. Horning, editor of the *Photo. Archiv.*, in Vienna, writes us that a fine collection is coming from his city. He says: "I hope to be able, according to the invitation of our American co-workers, to excite an animated participation of our photographers, and I shall be glad if I can succeed, to enable me to show you my esteem for the extraordinary exertions you have made in the interest of our art."

M. Adolph Braun, the renowned carbon art printer and publisher, has applied for 265 square feet of space, and promises to make a famous exhibit. Many French, English, and other foreign exhibitors will join in the display.

MR. ATWOOD SMITH, President of the Fire Patrol, has been appointed to organize a fire brigade for duty at the Centennial Grounds. This brigade will consist of 150 men, with all the necessary equipment and apparatus for effective service.

THE two houses of the Kansas Legislature have passed a bill appropriating $25,000 for the representation of the State at the Centennial Exhibition.

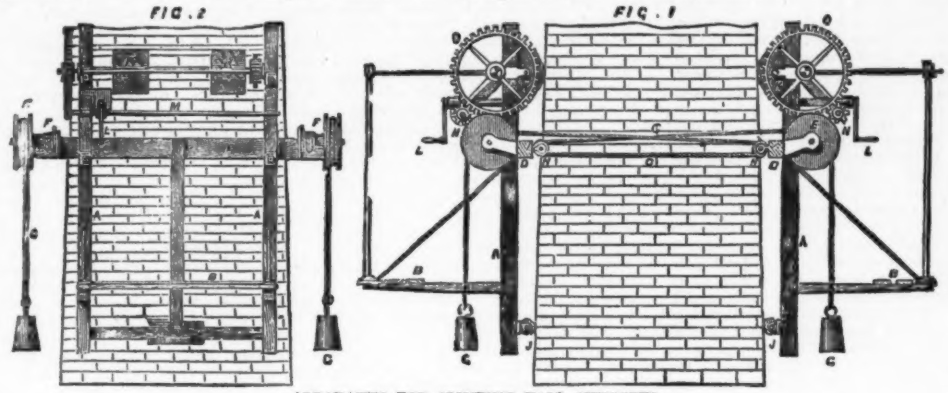
MAJOR J. W. POWELL, in charge of the United States Geological and Geographical Survey of the Territories, is about to make a tour through Arizona and New-Mexico to collect specimens and curiosities, and make plaster casts representing the various tribal peculiarities of the Indians in those territories. These will be placed on exhibition at Philadelphia.



THE INTERNATIONAL EXHIBITION OF 1876.—THE PHOTOGRAPHIC HALL.

APPARATUS FOR CLIMBING TALL CHIMNEYS.

A GERMAN contemporary describes an apparatus which is said to have been used in that country for climbing chimneys. As we have never met with the same in use, and as some simple and safe arrangement must prove useful for the purpose named, we reproduce the description here. Figs. 1 and 2 are views of the apparatus, which consists of two double-geared crabs, mounted upon a timber frame, and provided with two friction rollers and a tension clip arrangement. The two frames on opposite sides of the chimney, or other structure, are fac-similes of each other. A A is the timber frame carrying the platform B, which is provided with a railing; the operator stands on the platform. If a columnar structure such as a chimney is to be mounted, the frames are laid on two opposite sides, as will be seen in Fig. 1. The necessary adhesion on the surface of the structure is produced by means of the weights C C; the drums upon which they are wound are fixed on the cross-bar D, projecting beyond the sides. The weights are carried by ropes wound on the 12-in. drums E E, fast on the same axis on which the 4-in. barrels F F are mounted, taking the ends G G of the



APPARATUS FOR CLIMBING TALL CHIMNEYS.

rope. The rope goes over the pulleys H H, and forms thus a kind of pulley-block arrangement, so that the weights C C, which in this instance are 56 lbs., pull the upper parts of the frame toward each other. The lower frame-ends press against the surface of the structure with the rollers J J; the upper part is held by the rollers K K, pressing hard against the surface of the structure, and thus is provided sufficient adhesion to enable the machine to remain stationary at any height from the ground.

The operation of mounting is performed by two men, one on each platform, moving themselves up or down by turning the crank handles L L simultaneously. These are fast on the axis of a worm, driving a worm-wheel on the cross-spindle M, which carries on its end a pinion N, gearing into the wheel O. The latter is keyed upon the end of the upper cross-shaft, which carries another pinion on its other end, gearing into a wheel upon the axle that carries the wooden friction-rollers K. By turning the handles the machine ascends or descends on the column or chimney, and as the movements are effected by a worm, no ratchet or catch is required to keep it at rest. The friction of the rollers K is always equal, as the rope will give and take on conical structures from the large pulleys. For round columns the friction-rollers have to be hollowed out to suit the curvature.

THE THOMPSON INFERNAL-MACHINE.

VARIOUS descriptions, more or less inaccurate, of the machine which Thompson proposed to use in the destruction of the Moselle, have been published. We now place before our

FIG. 1.

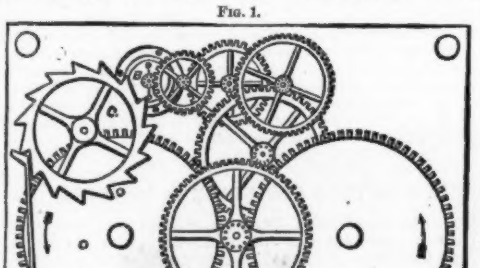
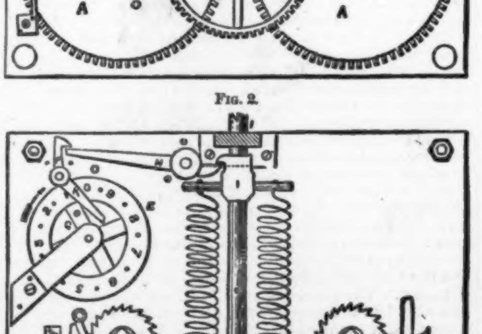


FIG. 2.



THE THOMPSON INFERNAL-MACHINE.

readers drawings and a description—for which we are indebted to our clever contemporary, *l' Illustration*—of the apparatus, which we believe to be perfectly accurate.

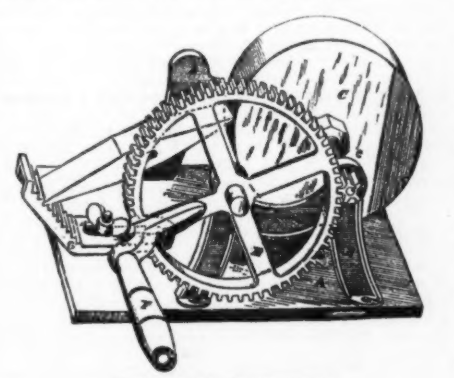
Figure 1 shows the interior of the apparatus—that is to say, the clock-work, which is inclosed between two plates of iron. A A, are two wheels, each driven by a strong coiled spring; these drive the train of wheels above; one of the wheels gives motion directly to a second pinion on the axis of a ratchet-wheel, C. The precise object of this ratchet we have been unable to discover, unless it is to prevent the train of wheel-work running backwards when the springs were wound up. The movement imparted to the ratchet-wheel is so slow that it requires ten days to make a complete revolution.

Figure 2 shows the percussion mechanism arranged on the outside of the plate. The axle of the ratchet-wheel C comes through the plate and carries the wheel E; one of the spokes of this wheel is fitted with a pin, G; when the wheel turns in the direction of the arrows, the pin comes in contact with the tail of the lever K F, and by pushing it aside, withdraws the hook at the top from the point of the lever H, which then releases the hammer or rod I I, which slides in guides, and is pulled downwards by the spiral springs at each side. The lower end of the rod impinges on a percussion-cap, or its equivalent, and detonates the dynamite. It will be seen that no safety-catch of any kind was provided, and the shock caused by throwing the box down on the quay liberated the lever H, and suffering the hammer to fall, so caused the premature explosion of the dynamite.

TOOL-GRINDING MACHINE.

By M. L. MOWRER, Dayton, O.

THE object is to furnish means whereby any tool can be ground at any desired bevel. A, base of a grinding-machine; B B, standards; C, emery-wheel; G, angle gauge-plate, which has a series of angle-teeth placed in the oblique face fronting the emery-wheel, as shown in the drawing; S, slot, made in the shank of the gauge, through which a set-screw passes to fasten it to the grinding-frame. This slot allows the gauge-plate to be set nearer to or farther from the grinder, to accommodate the machine to tools of different lengths.



TOOL-GRINDING MACHINE.

Angular steps in the oblique front-face of the gauge-plate G are for the bottom end of the tool to rest in, and the tool is ground with the desired bevel, according to the angle of inclination at which it is held. Each different step grinds the bevel in a different angle, and it may always be ground at the same angle. The number of steps and different degrees of inclination may, of course, be varied at pleasure.

[Nature.]

THE GLOW-WORM.

ALTHOUGH in several Natural History Encyclopædias, Scotland is excluded from the list of countries containing the glow-worm, I can aver that in Nithsdale and in the parish of Tynron, Dumfriesshire, they are quite plentiful. Yestreen, in Tynron, I observed one, to my surprise, shining by the wayside. It is a proof of the mildness of the season, no doubt, as I never saw them in December before, but have seen them several times as late as October.

When carrying one home one evening in my open hand, it contracted itself and leaped out of my hand. This is a power they possess which I have seldom seen mentioned. The light in winter is much feebler than in summer, but the time was ten o'clock, or more than six hours after sunset, that I saw it, whereas I never witnessed the glow of one in summer so long after dusk. Some that died with me forcibly reminded me of the poet's remark that between the rose's shadow and the very rose there was not a greater contrast than that between "the dead glow-worm and the worm that glows."

December 26, 1875. J. SHAW.

NOVEL BRICK-LAYING MACHINE.

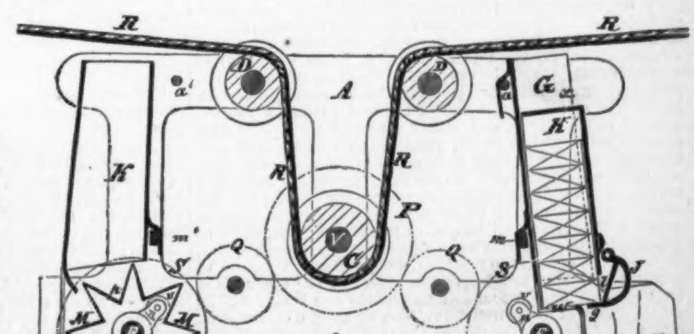
By C. FRANKE, New-York.

CONSISTS of a box containing the bricks at one end, a hinged valve to support the lower brick, and combined with a revolving shaft, provided with arms, acting against the lower brick, so as to push the same horizontally out of said box in a position to fall into its proper place upon the wall; and, in the arrangement of a suitable box or reservoir containing the required mortar or cement at the other end of the machine, situated above a revolving wheel provided with recesses or cavities, which receive the mortar and spread the same upon the bricks.

A A, frames to carry the different parts, provided with rollers B B extending the whole width between the frames, to support and allow the machine to roll upon the top of the wall W. On the forward end of the frames a box, G, is arranged, supported on suitable distance pieces or bars *a* and *m*. This box G is divided through partition-plates *x*, and extends nearly to the bottom of the machine. Into these compartments, boxes H, filled with bricks, are placed. These boxes H serve at the same time to carry the bricks up to the top of the wall, and are then directly placed into the box G, with their open top downward, to allow the bricks to pass freely out of the same; but the box G may be arranged with projecting side flanges on its sides and on the partition-plates to receive the bricks from a usual hod. The bricks placed either direct into the compartments of the box G or into boxes H, and then inserted into said compartments, rest upon projecting side-bottom flanges, *w*, provided near the bottom at the partition-plates *x*, and upon the projecting end *y* of a hinged valve J, moving freely on suitable pins or bolts fast to the box G. Below this box G a revolving shaft, E, is arranged, provided with arms *n n*, carrying suitable rollers *v* on their ends. These rollers pass in their revolution into the several compartments of the box G, and come thus in contact with the lower bricks, pushing the same forward off the side flanges *w*, with their forward ends still supported by the projecting end *y* of the hinged valve J, which latter will freely turn upon its centre to allow this forward motion of the brick. When the brick is nearly pushed off from the side flanges *w*, the upper forward end of the same comes in contact with the diagonal plate *s* arranged on the valve J, whereby the lower end of the brick, which has been resting upon the projecting end *y* of said valve J, will slide off from said end *y* just at the moment the after end of the brick passes the end of the side flanges *w*, and allowing thereby the brick to fall nearly square down upon the wall into its proper place. The valve J will then swing back again, ready to receive the forward end of the next brick. At the rear end of the frames a box or reservoir, K, is arranged, supported on the distance-bar *m'*. Below this box K a revolving shaft, F, is arranged, around which a wheel, M, is placed, made with recesses or cavities *p*. The mortar or cement is put into this box K, of which the recessed wheel M forms a bottom. The recesses or cavities *p* of said wheel M being thus filled with the mortar or cement, the same will be spread upon the previously-laid bricks during the revolving of the shaft F and wheel M. On the after end of the box K a plate, L, is arranged, extending the whole width of the machine, and resting close upon the brick wall, whereby the mortar or cement thrown upon the wall by the wheel M is equally distributed and spread over the surface of the bricks.

In the centre of the machine a shaft, V, is arranged, upon which a grooved pulley, C, is fixed, and at the upper part of the frames guide-pulleys D D are arranged, over which said guide-pulleys D D and the pulley C a rope, R, passes, the ends of which are firmly fixed at each end of the wall. Motion being given to the shaft V by means of a suitable crank, T, the machine will move either forward or backward upon the wall by means of the connection of the rope R with the machine, as above described. On one end of the shaft V a gear-wheel, P, is attached, meshing into wheels Q Q', which latter work into suitable wheels S S fast to the shafts E and F, and through which motion is communicated to said shafts E and F. To the lower part of the side frames A A plates W W are attached, projecting downward, and bearing against the sides of the wall. These plates act as guides for the machine, and at the same time scrape off any projecting or pressed-out mortar from the sides of the wall. If one side of the wall comes against an adjoining building the plate W on that side must be removed. When the machine has moved the whole length of the wall and laid the bricks as above described, the box G is moved to the after end of the machine, and the mortar-box K to the forward end, and the wheel M fixed upon the shaft E, when the machine is ready to operate in the opposite direction.

The wheels S, Q, and V may be made all of the same size, so as to bring their shafts in a line, and a box, similar to the box G, may be placed above the shaft of the wheel Q on the after end of the machine, and a box, similar to the box K, above the shaft of the wheel Q' at the forward end, while the shaft below the brick-box is fitted with arms similar to those on the shaft E and the shaft below the mortar-box with a recessed wheel, whereby the changing of the boxes when the machine is made to move forward or backward will be prevented.



NOVEL BRICK-LAYING MACHINE.

Scientific American Supplement.

No. 10

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THE INTERNATIONAL EXHIBITION OF 1876.

HYDRAULIC FEATURES OF THE EXHIBITION.

No. II.

THE arrangements at the Centennial for the exhibition and testing of machinery moved by and for the purpose of moving water and other liquids, including all such as come under the head of hydraulics, are by far the grandest and most comprehensive of any thing hitherto attempted; and a description of these, together with the excellent and extensive provisions made for the water supply to and drainage of the buildings appertaining to the Bureau of Machinery, although necessarily inadequate to convey to the reader a fair idea of their magnitude and fitness, can not fail to be of interest, and will show them to be as admirable in conception as they are almost wonderful in proportions.

The water supply used throughout the Exhibition buildings is taken from the Schuylkill River, whence it is raised by means of a pair of powerful Worthington pumping-engines located on its southern bank, to a stand-pipe situated a short distance, in a north-easterly direction, from the main Exhibition Hall. These engines or pumps have a capacity of over 4000 gallons per minute, or nearly 6,000,000 gallons in 24 hours, being equal to a work of over 7,000,000 foot pounds per minute, or about 220 net horse-power, required for the simple raising of this quantity of water to the necessary height.

The water-level in the stand-pipe will be about 220 ft. above high-water mark in the Schuylkill, and 115 feet above that of the floor of Machinery Hall, which latter gives a sufficient head of water to throw a stream from any of the multitudinous plugs or hydrants upon any part of the buildings; and considering the volume of water which can be discharged per minute, supplemented as it will be by a most complete system of hose stations and other fire apparatus, it would seem to render a conflagration next to impossible.

The stand-pipe communicates with mains which lead to the two larger buildings, the Main and Machinery Halls. One branch supplies a fountain located in the centre of "The Lake," which is just north of Machinery Hall, and thus the necessary water to keep it up to the level from which the condensing water for the large Corliss engines is taken. The injection-pipe of this engine, 10 in. in diameter, takes its water from near the centre of the fountain and conducts it about 640 feet to the condensers of the engine; the air-pumps discharging it, except the portion fed to the boilers, into the drains, and thence to the sewer on Elm avenue.

The Hydraulic annexe to the Machinery Hall is designed to accommodate all the hydraulic machinery which may be presented for exhibition, and it bids fair to eclipse every thing in this line which has yet been seen. For the facilities afforded exhibitors to operate and display the particular features of their respective machines, as well as the ease with which the visitor will be enabled to examine and investigate them, reflect great credit upon the management and designers. Situated centrally, and occupying about two thirds the length of the annexe, is a brick and cement basin or reservoir, 146 feet long and 60 feet wide, the bottom of which is 8 feet below the floor of the Hall. With the water-level 14 in. below the floor, it will contain nearly 500,000 gallons of water. It is supplied from one of the branches connecting with the main from the stand-pipe; the amount of water used here, however, will be small, and only that required to replenish the reservoir from time to time as the water may become too foul for use, to supply the small amount of waste incidental to all such exhibits, and the evaporation from its surface. From the reservoir are led four openings which communicate with two canals, one on either side of the basin, running lengthwise of the building, and nearly centrally under the floor space devoted to exhibitors, from which steam-pumps and kindred exhibits will draw their supplies; discharging again into the central reservoir. At the south end of the basin will be placed a very complete arrangement for testing turbine water-wheels, a part of which will constitute what may be called a Niagara in miniature. Upon six columns, three of which are to be supported upon an oblong pier erected within, and near the end of, the reservoir, and extending across it to within about four feet from each side, and the other three resting upon proper foundations outside the basin, will be placed a tank of boiler iron, 36 ft. long by 18 ft. 6 in. wide and 5 ft. 6 in. deep. On the side of the tank overhanging the reservoir, will be found a weir-overflow of the proper curved form, extending the whole 36 feet of its length, and about 32 feet above the level of the water in the basin, by means of which weir measurements of water discharged from it may be made. It will hold about 19.000 gallons. The water is discharged over this weir into the reservoir, and when it is known that there will be pumped into this tank no less than 30,000 gallons of water per minute, the effect can be better imagined than described.

This tank will be supplied principally by two centrifugal pumps, having each a 15-in. discharge-pipe, exhibited by Wm. D. Andrews & Bro., of New-York, and having each a capacity of 15,000 gallons per minute. They will be driven by two of Mr. Andrews' oscillating engines, rated at 100 horse-power each, but which, under the pressure of steam to be carried (70 lbs.) will be capable of working up to about 150 indicated horse-power, which, it will be seen, will be fully required for the work of supplying the tank at the rate above specified. The power will be transmitted from the engines to the pumps by two driving-belts 22 in. wide. Certainly this arrangement, together with the indicating of the engines, has all the elements of an easy and sufficiently accurate determination of the economy of this method of lifting water in large volumes. As I have said elsewhere, these pumps are capable of discharging jointly 30,000 gallons of water per minute, and this will enable them to fill the tank every 38 seconds, and empty the reservoir in 16⅓ minutes. The tank will also serve to obtain a head under which other pumps may discharge while under test. From the bottom of it will be led directly downward a penstock tube 4 ft. in diameter, and immediately under it will be a cylindrical chamber of brick and cement, 8 ft. in diameter, built in the foundations of the tank columns, in which the water-wheels will be placed, and communicating on one side with the main reservoir for the passage of the water discharged from them. Provision is made for the erection of weirs in the passage or tail race communicating with the basin for the measurement of the amount of water used by the wheels when being tested.

The power developed in the turbine tests will be measured in either or both of the following two methods, as may be decided upon by the judges: In one case the water-wheel shaft will, by means of bevel gearing, be connected with the line shafting of the annexe, driving the machinery therein which takes power from these lines, measurements of the power being made with the usual dynamometer. In the other case, what is known as the English plan, namely, the raising of weights, will be used, or, probably as a means of checking the one by the other, both plans will be resorted to.

The steam required for the two 100 horse-power engines and the other steam-using exhibits in the annexe, will be generated in a series of boilers situated in what is called boiler-house No. 3, which I shall describe when the arrangements are more nearly completed. There will be in all some six or seven boiler-houses, one of which was mentioned last week as furnishing steam to the large Corliss engines; they will contain a large variety of boilers, and will form the most extensive and complete assortment of steam generators ever brought together at one place.

The water-pipes underlying Machinery Hall are arranged as follows: Three mains enter the Hall at its eastern end, one of 8 in. and two of 6 in. diameter, and run parallel through the entire length of the building, dividing its width equally between them—the 8-in. main diminishing to 6 in. in the western end. At every 160 feet on the 8-in. pipe a 4-in. branch extends 70 feet each way, making seven of these branches in the length of the building; the 6-in. pipes at every 160 feet, so disposed as to be intermediate with the branches from the 8-in. pipe, have a 4-in. branch leading to the outside of the building. Similar branches extend to the outside at the ends of the building, as well as inside and outside of the Hydraulic Annexe. These branches are furnished with tees at convenient intervals, to which connection may be made by exhibitors requiring the use of water, and all of them terminate in a fire-plug or hydrant, of which there are 40 inside and 32 outside the building, making in all 50 distinct points at which hose may be attached, each controlling an equal area of ground or floor, and from which water may be obtained for fire purposes.

The system of drainage is as complete and extensive as the water-supply pipes, and the arrangement is much the same—the three principal drains leading to the sewer in Elm avenue. Perhaps an idea of the magnitude and cost of these provisions for the supply of water to and discharge of the liquid rejected from the building may best be formed from a few statistics. There is now underlying the Machinery Hall and its Hydraulic Annexe the following enormous amount of iron water-pipe: 340 feet of 10-inch, 1120 feet of 8-inch, 4640 feet of 6-inch, and 2260 feet of 4-inch—making a total of 8360 feet, or about 1⅗ miles; and of terra-cotta drain-pipe, including the mains leading to the sewer, there is: 2080 feet of 18-inch, 720 feet of 15-inch, 1600 feet of 10-inch, 1600 feet of 8-inch, and 2280 feet of 6-inch, making a total of 8880 feet, or nearly 1¾ miles. In addition to this there will be a very considerable amount of both connected with the several other annexes now in process of erection, as well as with the Shoe and Leather and other buildings, and the several boiler-houses, which will foot up a grand total of not less than about 4 miles of water and drain-pipe for the use of the machinery branch of the Exhibition alone.

Exhibitors still continue to hold off for the grand rush which must inevitably occur after the expiration of the present month, unless the next two or three weeks shall find them more alive to their own interests and convenience in this matter, and bring upon the ground some little showing of the enormous amount of material to be placed. During the past week, but one additional exhibit has made its appearance upon the floor, a hook and ladder apparatus by Mr. C. Schanz, of this city; visible progress has been made, however, on some of the foundations for the heavier classes of machinery.

PHILADELPHIA, Feb. 7, 1876. J. T. H.

HORTICULTURE AT THE FAIR.

THE well-informed correspondent of the *New-York Times* describes at length the arrangement of the Horticultural buildings and grounds, the allotment of space within and without, and the brilliant promises of this portion of the Exhibition. The portion following will be found of especial interest:

"The plot of ground nearest to the Woman's Work Pavilion has been ceded to American horticulturists and to dealers in rustic work. South of them Germany has 10,000 square feet, reaching from Belmont avenue to Agricultural avenue. But in this ground are included the areas occupied by the German Government Pavilion, the Brazilian Pavilion, and the kiosk of the Morocco Scheriff. At the junction of the Agricultural avenue with the main pathway of the Horticultural grounds—Fountain avenue—which runs due east and west, there is an open circular space, which may be decorated with a small marble fountain, if the display of the Italian marble work can spare such a thing. But the certain adornment will be the hyacinths, which, to the number of 22,200 bulbs, have been planted around the circle. The department planted 18,000 bulbs, private competitors 3000, and France 1200. On the other side of Agricultural avenue, opposite to the German Empire, England has one acre exactly, which will be filled up by her florists as they choose, only they must not change the forms of the plots which have been arranged in those serpentine lines which may have been remarked in the Central Park, up at the old convent. Just north of them there will be displays by two makers of rustic work, and east of them comes Spain, with 6000 square feet, which will be devoted to floral displays from Cuba. There will be a fountain in this allotment, and an office of rustic work made of wood from the ever-faithful isle. Then comes la belle France with 9000 square feet, in which are included those glorious old chestnut trees near the ravine, and that magnificent clump of pines, tall and stately, that borders on the new drive, and is close to the end of the bridge built so quickly and elegantly by Mr. Wilson, one of the engineers of the Pennsylvania Railroad. The Netherlands, just south of them, have only 200 feet, and perhaps I may here remark that Holland seems out of humor with this Centennial, and sends very little indeed to her trans-atlantic friends.

"Directly east of the building, where the broad plain slopes down to the steep river-banks, the department has reserved all the land for itself, and has arranged a circular walk, around the interior of which is a plot of ground with thirteen star-shaped parterres, and in the centre a fountain with a high jet of water. North of this is at present a wood of young pines, but these are to be cut away to admit of Austria's display in an allotment of 200 feet. North of this is the broad drive, on the other side of which is Lauber's restaurant, among the glutinous fragrance of the resinous pines. And this brings us up exactly to the north of the building, where an annex is to be erected mainly for the special exhibition of cut flowers, and plants in pots, etc., which are for sale. But for the opening six weeks of the Exhibition, England will have the sole use of this building to display the glories of her rhododendrons. Those who have been to the great London flower shows at old Gore House, in South Kensington, and at Kew, have a well-grounded belief that the bold Britishers will carry away the palm from the native exhibitors of the same shrub, which is purely American, and indeed clothes with unmatchable splendor the mountain-sides of the Pennsylvania and New-York ranges in early summer. Along the Delaware and the Susquehanna and the Juniata and up the steeps of the Catskills and Kittatinnies the glow of color in June passes belief. But in spite of all that, the shrub has been little cultivated in this country, and its wonderful capabilities have not been at all developed. This building will be 150 feet long, with a width of 50 feet. West of it there will be, among the grounds reserved for the Horticultural Department, a summer-house of wire, devoted to the exhibition of all the fabrics connected with gardening and floriculture into which wire enters. The spot chosen for the competitive display of the gladiolus is, I understand, outside of the Horticultural grounds, upon the other side of Belmont avenue and nearly in front of the United States Exhibition building. And I believe that in the competitive contest will be admitted shade trees and shrubbery plants, and that there will be active competition in this, with the odds decidedly in favor of England, where shrubbery-planting has been followed with extreme ardor, and has been raised to the rank of an undoubted art.

"Inside, the arrangement is as follows: Three out of the four forcing-houses are reserved by the Horticultural Department for its own needs, and the fourth is given to Spain for displays of tropical vegetation from Cuba. In the great palm-house in the centre England gets 460 feet for growing plants and 320 feet along the wall of the eastern end for miscellaneous exhibits, such as wire-work, terra-cotta pots and tubs, iron-work, pressed and dried flowers, and other matters of a general character belonging to the department. No other countries have any allotments of space for growing plants, and the remainder of the space in the palm-house is divided among American exhibitors and the department itself. But the three eastern rooms, which were to be utilized for restaurant purposes, have now been converted into chambers for the exhibition of miscellaneous articles connected with horticulture. Brazil, which applied for 2000 feet of inside ground, without any specification as to whether space for growing plants or simply for exhibition was desired, has been allotted 450 feet in one of these rooms, and the odd corners in the same room have been given to the Netherlands. Should it appear that the Brazilian exhibitors desire space for growing plants—as I can not but think was their intention—I sincerely hope that Mr. Miller will see the necessity of giving to that country the space that the department has reserved for itself. I would be loath to make any strictures upon the conduct of any department, but the truth is the truth. The Brazilian request for 2000 feet of space inside the palm-house is not courteously or even fairly met by giving 450 feet in an ante-chamber. There are many reasons why unusual attention and regard should be shown to all the South-American exhibitors, and considering that the Emperor of Brazil will come to the Exhibition, it strikes me that his realm is entitled to most marked courtesy. The remainder of the wall spaces, and of the rooms at the eastern and western ends, is divided among miscellaneous exhibits from private parties and from the United States, the Parisian Flower Company of New-York getting the north-west corner. The two entrances at the north and south will be flanked by bouquet and soda-water stands."

THE ALLOTMENT OF SPACE IN MEMORIAL HALL.

IN the main hall the pavilions, four in number, are given to four great countries—the north-western to Great Britain and the south-western to the United States, the north-eastern to France and the south-eastern to Germany. These will all be occupied by sculpture. Austrian sculpture will be exhibited in the two grand chambers on each side of the rear vestibule, which will be adorned with Italian sculpture. The small rooms on the north side between the English pavilion and the Austrian sculpture chambers are given to the United States for the exhibition of art industries, and the small ones on the other side of the vestibule are shared between the United States and Belgium for the same purpose. The grand corridor will be devoted to the exhibition of prints and engravings by England, France, and Austria. On the western side of the building the small art-gallery is devoted to the paintings of Sweden and Spain, and on the eastern side the corresponding art-gallery is shared between Austria and Belgium. The two grand art halls are devoted to the four holders of the pavilions, the western one being shared by England and the United States, and the eastern between France and Germany. The great central hall will be adorned with sculpture also by the same powers, each having a corresponding corner. But conspicuously in the centre of the north side of this grand chamber will be the reproduction in terra cotta of the marble group "America," in the Albert Memorial.

In the annexe, France has one long room, 100 feet by 40 in width, and also three rooms 40 feet square. She has, moreover, space in the corridors for water-colors. The other corresponding long room has been assigned to Austria, who has also two square rooms and a small part of the corridor for water-colors. Belgium has three square rooms, and one side of one of them is set apart for contributions from the Netherlands. Norway has one square room, and one side of it is given to little Denmark. England has three square rooms and an entire corridor for water-colors, which is none too ample, for England is *facile princeps* of the water-color schools. Canada has one square room. Sweden, Italy, and Spain have one square room each; the United States have five, Germany one, and one has been set apart for contributions from Brazil, Mexico, Chili, and the Argentine Republic. One corridor and

one square room remain for contingencies, and it is expected that Italy will require the former for water-colors, though no application has hitherto been made. It is thought, perhaps, that Germany may require the other square for paintings, as there has been considerable vacillation among the artists of that Empire. The main vestibule will be adorned exclusively with Italian sculpture.

The *Times* correspondent, who furnishes the foregoing information, further observes that there will be no art contributions from Switzerland or Russia, and that the number from Holland is surprisingly small.

CENTENNIAL CONCESSIONS.

THE *Tribune's* Philadelphia correspondent furnishes the following list of the concessions granted by the Centennial Board of Finance, for business privileges on the Exhibition grounds:

Centennial Catalogue Company, exclusive right of printing and selling the official catalogue	$100,000
Globe Hotel, use of part of grounds	10,500
Westland Passenger Railroad Company, transportation of passengers in narrow-gauge railroad through the grounds; percentage on receipts, estimated at	20,000
French Restaurant, P. Sudreau, New-York	6,000
American Restaurant, Tobias & Heilburn, Phila	6,000
Trois Frères Provençeaux, Restaurant, L. Gonyard, Paris	6,000
German Restaurant, Lauber, Philadelphia	6,000
Hebrew Restaurant, Charles Tollman, Philadelphia	6,000
Restaurant in Agricultural Hall, Gustav Mahl, San Francisco	5,000
Café in main building, Frank Green, Philadelphia	5,000
Eight other cafés, not yet awarded	35,000
Royalty of $3 per bbl. on beer, to be collected at the gates; estimated	50,000
Milk Dairy Association, Philadelphia	3,000
Vienna Bakery; manufacture and sale of Vienna bread	3,000
Chocolate and candy manufacturing; privilege of selling product	5,600
Soda-water privilege; Charles W. Lippincott & Co., Philadelphia, and J. W. Tufts, Boston, $20,000, and a royalty of $2 on each fountain, estimated at $32,000	52,000
Virginia Tobacco Factory; privilege of manufacturing and selling	3,000
Cigars and tobacco, 5 stands; Wm. S. Fleming & Co., Philadelphia	18,000
Centennial National Bank; banking privilege; building to cost $10,000	5,000
Safe Deposit Establishment; Farrell & Co., Philadelphia	5,000
Centennial Guide-Book Company; exclusive privilege of selling guide-books (no advertisements)	5,000
Centennial Photographic Association; $3,000 and 10 per cent of gross receipts over $30,000; estimated	5,000
Elevator, in tower in main building; Parrish & Stokes, Philadelphia, percentage of receipts; estimated	10,000
Machine-shop for doing work for exhibitors; percentage of receipts estimated	2,000
Glass factory for supplying exhibitors	3,000
Roll-Chair Company, $12,000, and $40 for each chair over 300, estimated $6,000, making	18,000
Pop Corn; J. L. Baker, Dayton, Ohio	7,000
Telegraph and messenger service, guides and interpreters; percentage on receipts, estimated	35,000
Department of Public Comfort; sale of stationery, care of parcels, use of rooms for reading, writing, etc.	16,150
Total	$450,650

TUNIS AT THE EXHIBITION.

AN occasional correspondent of the *Tribune*, writing from Tunis, says that an excellent and full selection of the products and manufactures of that country have been made for the coming Exhibition, the Bey having determined to make the display at Philadelphia at least equal to the very interesting Tunisian department in the Vienna Exposition. There will be a liberal supply of the silk and woollen shawls for which Tunis is famous; cloths of all grades, some woven in gold and silver, and specimens of embroidery in gold and silver on cloth and on leather; highly ornamented shoes for ladies' wear; saddles from the Bey's personal collection, some of them marvels of wealth and splendor; a fine array of Tunisian jewelry, table wear, and other handiwork, and much more that is characteristic of the industries of that portion of Northern Africa.

Not less interesting will be the evidences of the ancient arts and civilizations of Tunis, especially from the ruins of Carthage. One of the most remarkable of the antiques designed for the Exhibition is a mosaic representation of a lion seizing an antelope, recently discovered by native diggers and purchased by the English Consul. The mosaic is eight feet by ten, and perfect in every detail. Dr. Davis, author of "Carthage and her Remains," and other records of antiquarian study in Northern Africa, describes the work as follows:

"The Mosaic Lion was found within the precincts of the Byrsa of Carthage and in close proximity to the site of the temple of Astarte, the Juno of the Phœnicians. In this vicinity there appears to have been a temple dedicated to Diana. I am disposed to believe that this lion formed part of the pavement of that very temple. In this opinion I am confirmed by the fact that every other representation in this vast pavement had relation either to the chase or to wild beasts doomed to destruction by the arbitrary sentence of the Nimrodean law. Through ignorance or inability to raise them, every object was hopelessly destroyed in the attempt at removal, and the lion is the only object which was successfully taken up by one of my former workmen by the process which I have explained in 'Carthage and her Remains.'

"The boldness of design and the exquisite execution of this work of art assign it to the most flourishing period of Carthage. The coloring, the attitude, and the bend and position of every limb, exhibit the masterly skill of the artist; indeed, I do not consider it inferior to any of the mosaics I have found at Carthage and now deposited in the British Museum, and which have been pronounced by the best judges to be the finest in the world."

RHODE ISLAND has appropriated $10,000 for Exhibition purposes. Applications for space have been made by 150 citizens of that State.

EXHIBITION NOTES.

DIRECTOR-GENERAL GOSHORN pays to New-Jersey the high compliment of being the best worked-up State in the Union. Thanks to the efforts of the State Commissioners, its numerous branches of industry will be fully represented, about 40,000 square feet of exhibition space having been applied for by the single city of Newark. There will be a full display of minerals, ores, and pottery-clays; sands used in the manufacture of glass; soils, fertilizers, etc.; sections of the various woods of the State, and a full representation of its ornithological riches. A fine showing of fruits and vegetables will be made by the State Horticultural Society; and in the agricultural department an effort is being made to secure a full exhibition of cereals, to show that New-Jersey is not only a great manufacturing, fruit-growing, and gardening State, but has also fine grain-growing districts.

THE Pennsylvania Superintendent of Public Instruction has issued a circular to the school officers of the State with reference to the contributions required for the special educational building to be erected by that State. He calls for drawings, photographs, and models of school buildings; modes of lighting, heating, and ventilating school-houses; charts of school statistics; text-books and school apparatus; sets of blanks and forms, reports, rules, registers, courses of study, diplomas, certificates, medals, etc. Primary-school material is specially desired, and representations of scholars' work. All material of this sort must be on the ground by the 20th of April.

THE arrangement for lighting the Art Gallery is original and ingenious. The side halls are lighted from above, a ceiling of white glass being suspended underneath the skylight. At night the opaline ceiling will be lighted up by a large number of invisible gas-jets, the soft lustre of which will fairly imitate diffused sunlight. The main hall will be lighted in a similar manner. The ceiling is a suspended glass dome at some distance from the outer dome, also of glass. But the glass of the latter is transparent, while that of the inner dome or ceiling is white with a broad rim of purple. This inner dome is supported partly by stay-rods, which start from the iron ribs of the outer dome, and come together in an enormous pin shaped like a cross, and partly at the edges where it joins the trusses which support the ribs. The gas-jets, 2000 in number, will be arranged in three rings, one a little above the base and near the purple circle of glass, another in the middle, and the third toward the crown of the dome. Inside, on the floor of the main hall, the effect will be similar to that produced in the art halls; but outside, the whole outer dome will be a mass of brilliant, dazzling light.

MIDDLETOWN, N. Y., proposes to send to the Exhibition a five-year-old ox weighing five thousand pounds, and measuring twenty-five feet from tip of tail to tip of nose. If in high flesh his weight would be, it is estimated, a thousand pounds more. He comes from imported English stock.

A COMMITTEE of New-York underwriters and the Resident Committee of National Underwriters have addressed a communication to the fire insurance companies of New-York, suggesting a presentation at the Exhibition of what has been done by fire insurance companies during the past century, the growth of the business, etc., believing it will have a valuable effect in enlightening the people regarding this business. It also recommends the several companies to contribute to the Centennial Fund to the extent of one tenth of one per cent upon their respective capitals.

IT is proposed to issue, under the auspices of the Franklin Institute of Philadelphia, supplements of the *Journal of the Franklin Institute*, which shall contain reports and descriptions upon such subjects of interest in science and the mechanic arts as shall be exhibited at the approaching Centennial Exhibition, and may be offered for notice from time to time. The publication will be edited in chief by the present editor of the *Journal*, assisted by the Committee of Publication. The supplements will correspond in size of paper and typography to the regular issue of the *Journal*.

THE latest Centennial idea is a children's roll of honor, to consist of an illuminated parchment-scroll, inscribed with the names of children who undertake, during the year, some special reading of American history or biography, and who also devote, regularly, a part of their earnings or savings as a "Centennial Offering" to some patriotic or unselfish purpose. This roll, in a beautiful casket, will have a place at the Exhibition, and when that closes, will be deposited with some Historical Society.

THE entire exhibit from the Canary Islands has been shipped from Teneriffe to Cadiz for transhipment to Philadelphia. They form a part of the Spanish exhibit, and embrace, among other articles, silk, woven, spun, and raw; wines, oil, almonds, birds, canary-seed, raisins and figs, cigars, arrowroot, aromatics, cochineal, and cotton.

TURKISH merchants and other intending exhibitors are said to be holding back, through distrust of the honesty of the Turkish Commissions. Many of the exhibitors at Vienna had their goods sold by the officers who had them in charge, but, Turkish fashion, neglected to make returns. The fear of a repetition of this proceeding prevents many consignments that would otherwise be made.

IT is reported that the richness of the British display is largely due to the personal interest which Queen Victoria has taken in the Exhibition, which has been the means of rousing her from the lethargy of sorrow into which she was plunged by the death of Prince Albert. She looks upon the Centennial Exhibition as in a great measure the result of his inaugural of 1851, and cherishes it accordingly. She not only sends five of her own private pictures, commemorative of her marriage and other family incidents, but has influenced many leading manufacturers to contribute. The reproduction of the group "America" in the Albert Memorial comes by her desire.

QUITE a stir is reported in the manufacturing city of Reus, near Barcelona, Spain, with reference to the Centennial. There will be sent a variety of celebrated wines, dry fruits, preserves, cotton and linen cloth, silk fabrics, olive oils, inks, rum (scented and pure), sulphate of baryta, paper, minerals, wheat, sulphate of lime in powder, soap, woollen fabrics. The steam silk factory of Reus covers an area of several acres and furnishes employment to more than three thousand operatives. The cotton-goods factories, though not on so grand a scale, are nevertheless important, and represent altogether over $2,000,000 capital. In the neighborhood there are extensive and productive wine and oil mills, representing important interests, and giving to the place a Yankee appearance for thrift and enterprise.

THE Spanish Government has asked permission to invade our territory to the extent of sending a detachment of military engineers to superintend the reception and custody of the articles for that part of the Exhibition which has been allotted to Spain, the officers and men to wear the same uniform and bear the same arms which they do when at home.

MR. JAMES BELL, of Arnprior, Canada, is preparing a collection of mineralogical specimens, including gray, white, and variegated marble, hematite and magnetic iron, phosphate, whetstone and hone, steotite, grit stone, shell marl, cobalt, three kinds of mineral paint, and specimens of slate and copper. All the minerals were got within twelve miles of Arnprior.

SIR EDWIN BARRET, President of the Victoria Commission to this country, and General Levy, will be here some time in July. The Victorian Exhibition has closed, and the goods from that Exhibition are now on their way here. The indications are that there will be a great many Australians here this year.

THE Swedish wood-carver, Oestergren, favorably known in England, is said to be preparing a chess-board for exhibition at the World's Fair in Philadelphia, the pieces of which are symbolical of the struggle between Ultramontanism and the modern spirit in Germany. On one side of the board appear the Emperor William and the Empress Augusta as King and Queen, Prince Bismarck and the Minister Falk as Bishops; the knights are Prussian Uhlans, and the pawns are soldiers and recruits. On the other side stands Pius IX. as King, while his queen is an abbess holding a waxen taper well-nigh burned out. The bishops are cardinals, the knights are monks riding on asses, and the pawns are monks on foot.

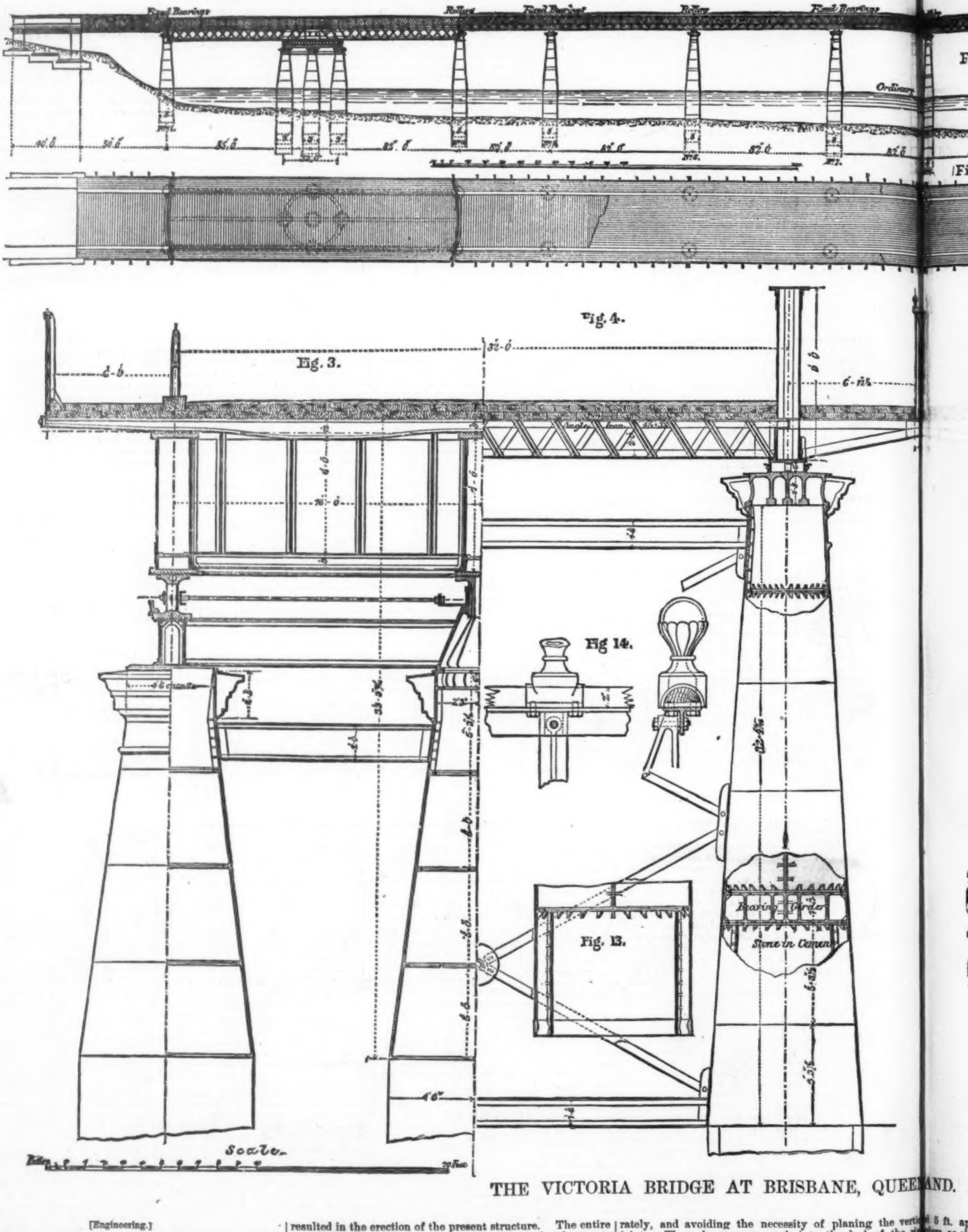
ONE of the most curious things at the Philadelphia Exposition will be an architectural plan of the City of Mexico. Its dimensions are 330 by 231 feet. It will display all the characteristics of the city, and will be peopled by 60,000 leaden figures dressed in appropriate costumes, some for the opera, ball and social party, and others vending fruit and ice-cream, carrying baskets and rolling barrels. In the streets will be 1900 coaches, an equal number of other vehicles, and a lot of artillery-pieces.

IT is officially announced that should the Scottish Club's proposal to send a team be accepted, the project for a British rifle team will fall through, as England is resolved not to participate except with a united team.

TEMPERANCE men seem to have little faith in the business value of temperance practices. The Centennial managers have been very desirous of having one or more first-class temperance restaurants on the grounds, but as yet have had no applications. No standing bars, however, will be allowed in any of the restaurants. In the Machinery Building, there will be five cafés, in which no malt wines or other spirituous liquors will be allowed; in the main building four cafés in which there will be no spirituous liquors; in the Agricultural Building as yet but one has been determined on, and that is restricted to the "golden" wine of California. The regular restaurants are without other than the general restriction of no standing bar.

CORAL REEFS AND ISLANDS.

THIS was the subject of Professor Joseph Le Conte's second lecture recently delivered before the School of Mechanic Arts, San Francisco. The growth of coral, he said, which has been continued from the time the bottom of the Pacific began to subside until the present time, goes beyond the present geological epoch. One foot of growth per century, corresponding with one foot of subsidence, for a depth of 10,000 feet, would be just 1,000,000 years. Dead corals at a depth of 250 feet would represent a period of from 12,000 to 15,000 years. Below that depth there is good reason to believe that the coral goes beyond the present geological epoch, and is prolonged throughout the whole tertiary period. Corals continue to live and to build at depths not exceeding from 60 to 100 feet in open sea, and this shows that the same causes which operated to form land in past times are still operating. Limestone, which forms so large a portion of the earth's strata, he believed to be chiefly the product of organic growth; and he was of opinion that the whole western side of the American continent, from the Mississippi westward, has been upheaved higher and higher as the correlative of the downsinking of the Pacific bed. This upheaval has proceeded to the extent of 8000 feet along the plateaux from the Mississippi westward, without taking into consideration the mountain-chains, and as the general surface of the country rose higher and higher, those wonderful cañons, eroded by such rivers as the Colorado, were formed gradually. The lecturer then entered upon the principal theme of his lecture—the coral formation of the coast of Florida. The southern point of the Florida peninsula he examined with Agassiz in 1850 and 1851. Before that date the whole of Florida was supposed by geologists to belong to the tertiary age, but the investigation demonstrated that Florida is a recent coral formation, belonging to the present geological epoch, or at all events is subsequent to the last, and that the formation is still in progress. The southern part of Florida is composed wholly of limestone, twelve or fifteen feet above sea-level. In the interior of the southernmost part are the Everglades—a swampy ground, dotted with hummocks, not more than two feet above the surface of the sea. Outside the coast-line of the mainland runs the line of the Florida Keys, 150 miles in length, and terminating in the Tortugas—none of which islands are more than fifteen feet high. The water between the Keys and the mainland is very shallow. In the chain of the Keys are a number of islets called Mangroves, from being dotted with trees of that name. These are formed of mud, and are only a foot or two above the water. Lying outside of the Keys, which are of limestone, is the living barrier of coral reef, between the great semicircular sweep of which and the Island of Cuba runs the swift current of the Gulf Stream. The whole of lower Florida, from the land north of the Everglades, a distance of 300 miles, has been demonstrated to be a coral formation. The Everglade swamps, lying between the limestone on the north and the limestone on the coast, have simply been formed by the mangroves, whose spreading roots, intercepting the sediment, rapidly advance from the sea-shore and form land; and the shoal-water between the Keys and the coast is the counterpart of the Everglades before the mangroves formed the land. In time the deep channel between the Keys and the outer reef will fill up, and the outer reef will become the southern boundary of Florida. Mr. Le Conte did not think the coral formation will proceed beyond the present outer reef, because the Gulf Stream runs too strong to deposit the sediment necessary as a formation for coral-building in deep water. Between this reef and Cuba the water is almost unfathomable, and corals do not live at a greater depth than 100 feet.



THE VICTORIA BRIDGE AT BRISBANE, QUEE

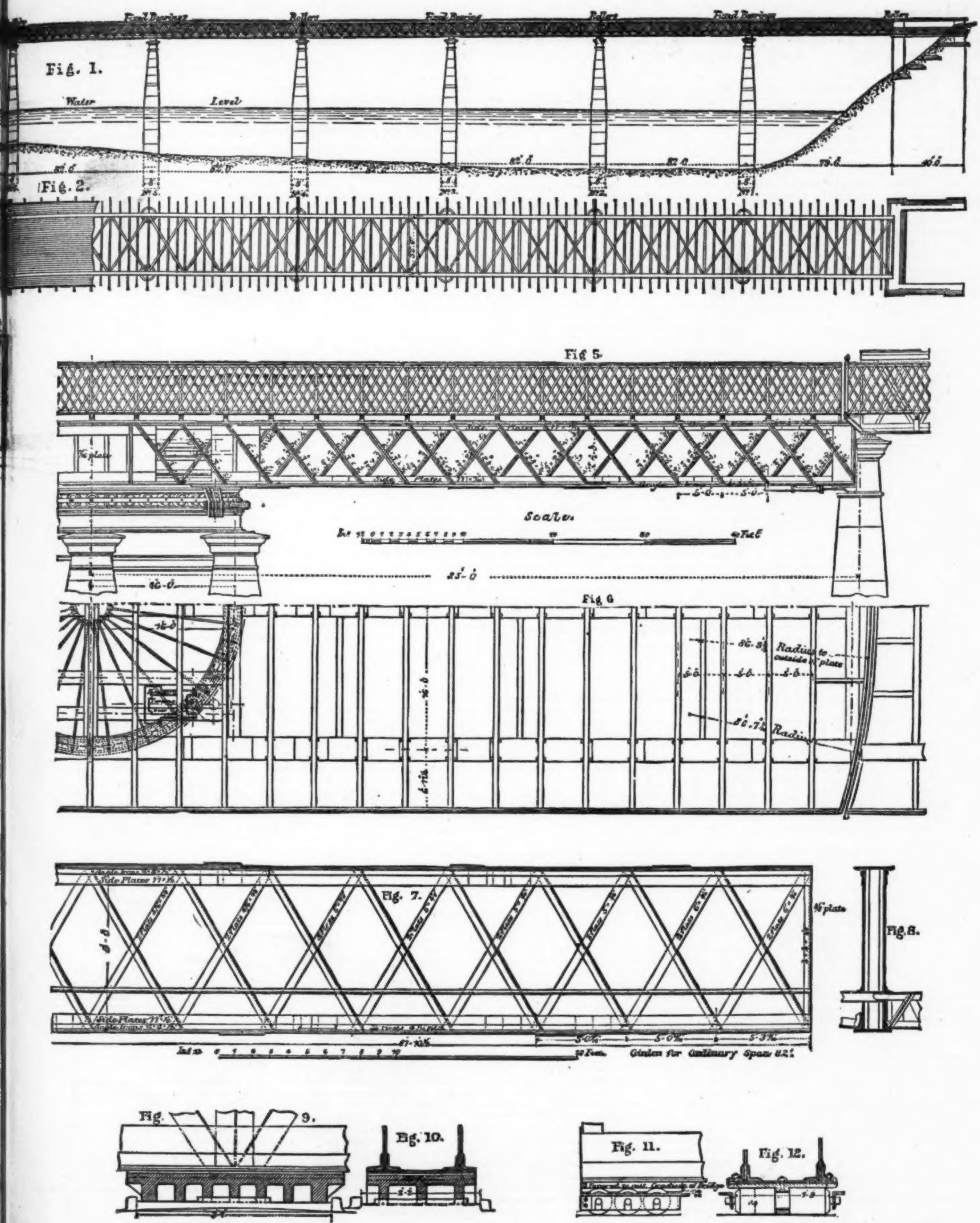
[Engineering.]

VICTORIA BRIDGE, BRISBANE.

WE give this week a two-page engraving of the Victoria Bridge, erected at Brisbane, from the designs of Messrs. Robinson and I'Anson, of Darlington. This bridge spans the river Brisbane, and forms the means of communication between the northern and southern portions of the city of Brisbane, the capital of Queensland, the traffic between which is large and increasing. The separation of the two halves of the city by the broad and often rapid river had long been a source of great inconvenience to the inhabitants, and in the year 1863 the corporation of the city determined to build a commodious and substantial bridge, which should, at the same time, cause no hindrance to the development of the important shipping interests, and measures were taken which resulted in the erection of the present structure. The entire length of the bridge is 1080 ft., and between the abutments on the shores, 1013 ft., divided—as shown by Fig. 1 of our engravings—into thirteen spans, comprising nine of 82 ft. each, two of 52 ft. 6 in. each, and a double-armed swing span of a total length of 170 ft.

The piers, excepting that for the swing and those adjoining it, consist each of two columns (see Fig. 4) formed of cast-iron cylinders 8 ft. in diameter from the bottom up to the ordinary water-level (where they were cut off and a wrought-iron ring inserted), and tapering from that point to a diameter of 4 ft. at the top, finishing with a strong cast-iron cap, surrounded by an ornamental cornice. Each cylinder was cast in one piece, and when turned and finished was split into three segments through vertical flanges by which it was finally bolted together, thus obviating that warping of the segments which frequently occurs when they are cast separately, and avoiding the necessity of planing the verti joints. The columns were sunk into the bed of the ri until a firm foundation was reached, and after a layer ashlar had been built across the bottom of the lowest cylind all above it were lined with brickwork and then filled with core of concrete as high as the flood water-level. At t point is a short cylinder containing cast-iron girders, whi rest on ashlar, built on the top of the concrete. Above t girder-cylinder the column is hollow to the top. From low water-line to the top, each pair of columns is bra together by wrought-iron girders and ties.

The whole of the superstructure is on a gradient of 1 90. The fixed portion consists of lattice girders 9 ft. dee as shown in Figs. 8 and 9. Every two spans are continuo and the extremities rest each on three rollers 6 in. in diam ter to provide for expansion. The roadway is laid betwe the main girders, and is carried on lattice cross-girders 2 ft. de



[QUEENSL]AND. DESIGNED BY ROBINSON AND I'ANSON.

...d 5 ft. apart, resting on the lower flanges of the main ...ders, as shown in Fig. 4; and on either side is a footway, ...ried on wrought-iron cantilevers, and provided with light ...ice-work hand-railing, which is supported at intervals of ... ft. by ornamental cast-iron brackets.

The swing (see Figs. 3, 5, and 6) is balanced on a cluster ... five columns, each 9 ft. in diameter from the bottom to the ...ter-line, and from thence tapering to 5 ft. at the under ... of the cap. These columns are filled to the top with ...terials similar to those in the others, and are intimately ...nected together by wrought-iron girders and bracing-bars. ... adjoining piers are filled to the level of the under side of ... swing girders. The swing is double-armed, composed of ... lattice-girders, each 7 ft. deep, and when open, affords ... passages of 60 ft. 6 in. clear width. The roadway passes ... the top of these girders, and rests on shallow plate cross-...ders. All necessary hydraulic machinery is provided for turning the swing, but for the present a neat and effective arrangement of hand-gear, designed by Mr. Jones, the resident engineer, is used.

The roadway is 30 ft., and the footways each 6 ft. in clear width. The flooring consists of two layers of native hard wood, the lower layer of planks 9 in. by 5 in., being laid longitudinally, and the upper, 6 in. by 2½ in., transversely. The weight of the cast-iron used in the bridge is 1190 tons, and the wrought-iron, 911 tons, making a total weight of 2100 tons.

The foundation-stone was laid by Sir George E. Bowen, then Governor of Queensland, on the 22d of August, 1864, and the work progressed satisfactorily till the year 1866, when, owing to the failure of the Bank of Queensland, it was suspended till June, 1870, at which time arrangements were made by the corporation of Brisbane with the late Mr. Thomas Brassey to complete the structure. On the 15th of June, 1874, it was opened with great ceremony by the Marquis of Normanby, the governor of the colony.

The engineers were, as we have said, Messrs. Robinson and I'Anson, of Darlington, and the resident engineers, the late Mr. Thomas Oldham, and subsequently Mr. J. R. Jones. To this latter gentleman credit is due for having successfully raised from the bed of the river several fallen columns, and readjusted others which had not been sunk to their full depth when the work was suspended, and had consequently been disturbed by the heavy floods during the four years' interval which elapsed before it was resumed. The original contractor for the erection was Mr. John Bourne, and the manufacturers of the iron-work were Messrs. Peto, Brassey, and Betts, of Canada Works, Birkenhead.

THE span of the great suspension-bridge over the East River, New-York City is 1600 feet.

UNHEALTHY TRADES.

A LECTURE BEFORE THE SOCIETY OF ARTS, LONDON, BY DR. B. W. RICHARDSON.

(Continued from page 138.)

Dusts of Textile Fabrics.—The particles of textile fabrics vary in their action according to the substance of which they are composed. The particles of wool, fluff of wool, appear to induce no really deleterious effects on the lungs; indeed, looking at the comparative mortality of workers in wool, we might almost say that they are favorably exempted from disease; as if the soft, oily dust of the wool rather protected the bronchial surface from irritation than irritated it.

To a considerable extent, this same rule applies to the dust or fluff of silk, but I have seen an exception to this rule. In the trimming manufactories, where the business of carrying on silk trimming is conducted in close rooms, I have found the workers suffering from the same kind of bronchial irritation as that which obtains from the dust of wood. According to my observation, this only occurs when colored silk is used by the trimmer, and it is therefore possible that the dye-stuff used in the color may be the actual source of the mischief.

My attention was first attracted to this point by the circumstance of a young woman being brought to me, who was supposed to be suffering from hæmoptysis, or spitting of blood. She was, in fact, expectorating freely something that seemed to be, at first sight, deeply tinged with blood. At the same time, she exhibited no symptoms of disease which indicated consumption or other serious affections of the lungs. Indeed, she was so healthy, generally, except for a slight cough, it might have been assumed against her that she was simulating the very serious malady from which it was presumed she was suffering. I took the precaution to examine the colored secretion microscopically, and detected in it the fibre of silk colored with red substance. On inquiry upon this, I found that the young woman was engaged in a trimming manufactory, in which red silk was being, at that time, largely used, and that she derived the red particles from the dust or flue which she inhaled; other women in the same business were, I discovered, similarly affected, but suffered only from irritative cough when they were using red or other colored silks. White silks did not cause irritation, from which fact I draw the inference that the dye-stuff rather than the material is the irritant.

The fine particles or dust derived from cotton, flax, and hemp are very different in their action from those of wool and silk. The cotton flue produces some bronchial irritation; but the worst injury results from the dust of hemp during the process of dressing. The quantity of dust lost in hemp-dressing may be inferred from the fact that for every 112 lbs. weight of hemp employed there is a loss of 4 lbs. This dust produces a most severe irritation, which, however, is purely bronchial, attended with painful expectoration and strangling cough. Russian and Polish hemp both produce these effects. Neapolitan hemp does the same, and something more. In the dust of the Neapolitan hemp there is distributed a peculiar odorous substance, the dust of some vegetable or grass, the inhalation of which causes shortness of breath, constriction of the throat, and spasmodic cough in recurring paroxysms, which continue for many hours after the inhalation ceases. For the sake of experience, I obtained a specimen of this hemp, and after shaking it in a large bottle, I inhaled the dust. The symptoms induced, and as I have described them, were immediate. They resembled almost completely the symptoms of the disease known as "hay fever." I was unable by any examination of the hemp, microscopical or chemical, to detect the specific agent that was at work. Even dressing the hemp does not remove this substance, for the symptoms are common to the spinners of the hemp after it is dressed, although they work in the air. The dust from flax-dressing, which is in fact but a continuance of the hemp process on a finer material, is equally irritating, and the loss of flue in flax-work is nearly the same as in the preparation of hemp.

The ordinary symptoms produced by the dust of the hemp, and which are felt by the spinners as well as the dressers, are merely those of bronchial cough. They are not alike in all. In some the cough is dry and husky; in others, it is a loose cough, with profuse bronchial secretion. One worker in this business, who had been engaged in dressing flax for thirty years—twelve years in the country and eighteen years in London—told me he had never met with a single fellow-workman who had not suffered more or less from this irritation; but those who worked in the country suffered much less than those who worked in London; he had known a few who had lived to a fair old age. The work he considered to be much more easily carried on in warm and dry than in damp and cold weather. He had himself been a sufferer from the very first, and had been obliged, temporarily, to leave his employment on several occasions

It is worthy of notice that these injurious effects from flax-dressing and spinning were noticed by one of the first sanitarians. They were very carefully described by Ramazzini, in his work, *De Morbis Artificum*, published as far back as the year 1717.

Thackrah, in his famous work on "Effects of Arts, Trades, and Professions on Health and Longevity," observes the same order of facts, and adds that the operatives seem to suffer most on leaving their work at night; that they are peculiarly susceptible to atmospheric vicissitudes; that the cough is harsh, and is not cotemporary with a difficulty of breathing, but precedes it by months, or even by years. He adds, further, that dressers of flax "are subject to indigestion, morning vomiting, chronic inflammation of the bronchial membrane, inflammation of the lungs, and pulmonary consumption. The dust, largely inhaled in respiration, irritates the air-tubes, produces at length organic disease of the bronchial membrane, or of the lungs themselves, and often excites the development of tubercles in persons predisposed to consumption." I am obliged to draw the satisfactory inference that, since Thackrah wrote the above, now forty-three years ago, improvements have taken place in the health of these industrials; certainly, some of the severest maladies of which he writes are now greatly reduced.

In my *Journal of Public Health* for January, 1859, Mr. J. Jardine Murray, then of Edinburgh, and now of Brighton, reported a very valuable inquiry bearing on this same subject—namely, on the health of those who work among rags—those who in "the inferior streets and alleys of the metropolis put out the tawdry stump doll, or the dirty bunch of parti-colored ribbons over the signboard which indicates that the keeper of the dingy store is ever ready to give the highest price for all descriptions of rags and bones."

Mr. Murray expected, very naturally, that he should find amongst the workers in these tattered and filthy stores some suffering from contagion, others from the products of decay of the animal and vegetable constituents of the rags; others from inhaling and swallowing dust. An inquiry made by him at twenty-three paper-mills to which rags were sent, and of twenty-three rag-collectors in Edinburgh, led to the curious return, that epidemic or contagious disease from this source was practically unknown amongst workers in rags, that there was no evidence of disease from the decomposition, but that some workers suffered from bronchial affections, cough, and shortness of breath from inhaling the dust, which is cast off in large quantities from the rags when they are made to revolve in the wire-cloth cylinder to free them from dust.

I have brought down, for those who would like to see them, Mr. Murray's abstract of statistics from paper-makers and rag-collectors. The paper-makers admit of no other affection incident to working with rags, except from the effects of the dust, and on this very few of them comment unfavorably. The rag and bone collectors tender an unusually fair bill of health. One of this class, who had been in business thirty years, who employed, on an average, ten hands, and who collected two hundred tons of rags, on an average, every year, reported that there had been only one death among his rag-workers during ten years.

The dust from corn, consisting principally of the residue of dried husk, is rarely present in sufficient quantity to create serious evil; but such mischief as it does create is of the character of bronchial irritation.

The dust which is diffused in the rooms where earthenware is manufactured, dust of clay, or rather the dust of a silicious material which is mixed with the clay, produces an action of two kinds. The dust which is given off in the earlier part of the manufacture, while the clay is but partly dried, acts rather as an obstructive than as an irritant. In a later period of the process, when the earthenware is becoming hard-dried, and the dust firmer, finer, and drier, more serious mischief is effected, for now the dust partakes almost of the character of fine sand or powdered glass, and the mischiefs induced are the same, in character, as those which affect the sandpaper-makers and stone-cutters. Amongst workers in earthenware during the stages of drying and turning, are implanted bronchitis, pulmonary consumption, and asthma.

My friend, Dr. Cholmeley, has recently observed a peculiar bronchial irritation brought on in the carrying out of a comparatively new industry—namely, that of hair-brushing by machinery. The fine particles of hair carried off by the brush in its rapid revolutions give an atmosphere of dust which is extremely irritating, and which is carried into the very face of the operator. Dr. Cholmeley has known three hairdressers who have been obliged to leave their occupation, owing to the injuries that have been inflicted upon them from this cause. The wig-maker and hairdresser is, as I have myself observed, subjected to a similar danger, and the unhealthiness of his occupation is shown by the rate of his mortality, which, from the age of twenty-five onwards, is greatly above the average.

Reviewing the effects of these simple irritating dusts, we find added to our industrial pathology three more diseases:

Chronic Bronchitis and Bronchial Phthisis; Spasmodic Asthma, resembling Hay Asthma; Asthma.

Effects of Inorganic Poisonous Dusts.

In some parts of the paper-staining process, and in the coloring of artificial flowers, the dust of arsenical coloring compounds is thrown off. This dust is more than a simple irritant to the lungs; it is dissolved, in some cases, in the mucous secretions of the mouth and throat, is swallowed into the stomach, and sets up the irritative symptoms of slow arsenical poisoning—namely, pain in the stomach, redness and soreness of the throat, and irritability of the skin. I have seen one instance of this kind where the symptoms amounted to a modified form of gastro-enteritis. In the mildest of these irritative states of the mucous membrane, there is created a persistent dyspepsia so long as the excitant is at work. Arsenical salts are employed for the preservation of some organic substances, as, for instance, for the preservation of the skins of stuffed animals; and, under some circumstances, where the preserving process is not carried out with proper skill, particles of the salts are thrown off, float in the air, and so become inhaled. I have twice seen symptoms of arsenical irritation produced in this manner in persons who have the dusting and cleaning of stuffed animals in close and badly-ventilated rooms.

Salts of mercury are likewise employed in preserving furs and skins, and from these the poisonous particles of the metallic compound are given off. In this manner, packers of furs are affected, sometimes very seriously. A typical case of this character is related in the Guy's Hospital Reports, in 1864, by Dr. Taylor. The man affected was thirty-two years of age, and was admitted into Guy's Hospital in December, 1863, under the care of Dr. Owen Rees. He had been engaged four years in packing the skins of animals that had been prepared with an acid solution of mercury and then dried. Until the skins were perfectly dry, he had nothing to do with them. His duty was to pack them afterwards. He was salivated for three months, recovered, and remained in good health until twelve months before he was admitted into the hospital. At that time his hand became unsteady, and he could not shave himself; a little later, he lost power in his limbs when standing or moving, and afterwards began to have twitchings and tremors when in bed. Soon he was unable to walk without assistance, and a day or two after admission into the hospital he was seized with delirium. He became paralyzed and unconscious, and died within fifteen days from the time of his admission. Mercury was detected in the organs of the body of this man, and some portion of the fur with which he had worked exhibited, on analysis, abundant evidence of mercury. Dr. Taylor is of opinion that, in this instance, the mercury was absorbed by the skin, as well as inhaled.

To the schedule of industrial pathology, we must add three more conditions of disease—namely:

Gastric Irritation and Gastro-enteritis; Mercurial Salivation; Mercurial Tremors and Muscular Paralysis, ending in fatal Cerebral Exhaustion.

Effects of Soluble Saline Dusts.

Fine particles of some of the soluble salts of iron, especially copperas or sulphate of iron, are sometimes inhaled. This salt, sulphate of iron, is used in fur-dyeing for dyeing skins black. After the skins have been treated with a solution of the salt, they are dried and beaten with a bat, and thoroughly brushed. The copperas dust diffused freely through the air is an excessive temporary irritant to the lungs, but the solubility of it seems to reduce its power as a promoter of permanent disease in the lung tissue. Its action on the bronchial surface is therefore less permanent than is that of many other irritating substances. Owing to its solubility and to its corrosive action on bony substances, it is extremely destructive to the teeth, which are almost invariably affected by it. The teeth are rendered brittle and generally carious. The grinding down of the color-stuffs from the large crystals into the state of fine powder leads to similar bad results. We add, therefore, to the list of industrial diseases *Caries of the Teeth.*

It is right that I should mention on this point what great improvements have been made in the drying process. Many years ago—twenty years at least—the Messrs. Appold introduced into their manufactories a ventilating shaft, which proved of great service, and Mr. Davenport informs me that in all the better manufactories now the bat, with which the skins formerly were beaten has been replaced by a machine which acts more efficiently, and which entirely protects the workman from the dust. Except in the small and worse-conducted shops and factories, the evils I have described have ceased to exist.

Effects of Organic Poisonous Dusts.

The dusts arising from tobacco-leaf during the process of making cigars is most injurious. While the leaf is being rolled up, unless the ventilation of the room is exceedingly perfect, the dust from broken leaves and siftings is inhaled, and proves most irritating. In the course of drying, the dust and vapor from the drying-room act in combination, and lead not only to oppression of breathing, but to dryness of the throat, and, in the young, to giddiness and nausea. One workman told me that he never got over the bronchial irritation produced by this dust until he left his work at night; then the effect subsided.

The dust produced in the various processes of snuff-making is still more injurious. The tobacco-leaf, finely cut up, is mixed with lime-water, salt, sometimes even floor-dust sweepings, and, in yellow snuff, with red lead. These ingredients, placed in a bin and heated two or three times to give sharpness to the snuff, are frequently turned over, in order to facilitate the process of drying. While this turning is in progress, there arises a dust with a smoke, which affects the younger workmen, so that they become faint and vomit, until, by use, they are rendered tolerant of the poisonous matters they inhale. In the further process of finishing the snuff, after it has been ground and dried, there is a practice of what is called sifting, preparatory to adding "liquor"—namely, salt and water—to make weight, and scents to give perfume. The sifting charges the air with dust, which is as injurious as the smoke, and which produces the same symptoms in the young—namely, retching, faintness, and great irritation of the bronchial passages. The rooms in which these works are carried on are too often close and unventilated, and thereby the irritation of the throat, the cough, and the nausea are much increased. Sifting the "shorts" is more hurtful than rolling the cigar. The consolation of the workman is that he gets accustomed to the poison, if he only keeps to the work, and at last gets over the symptoms. In so far as the acuteness of the symptoms is concerned, he is generally correct in this respect, but it is not to be presumed that the mischief stops at this point. The system of the workman becomes tolerant in some measure, but the tolerance is partial only. Chronic maladies are induced by continued application, which are of serious and even fatal import. Those workmen who are disposed to pulmonary consumption suffer readily from that disease, and in others of better constitution, less serious, but still serious derangements are manifested, the most common of which are a persistent dyspepsia and that pale and bloodless condition to which the technical term *anæmia* is applied by the physician. Another common symptom is a rapid and irregular action of the heart. Palpitation of the heart and intermittent action, in which the organ hesitates in its beat, are marked phenomena. I think I may indeed say that in these workmen the action of the heart is never at its full power, never perfectly regular so long as they are following their employment. In cases where the chronic effects are most intense, the muscles of the body share in the feebleness and disturbance. The hands become tremulous, the lower limbs unsteady. In two examples, I have seen the breathing muscles influenced, and a peculiar spasm of an extremely painful kind produced through the chest, followed by a faintness, as if the sufferer were about to die. Lastly, the organs of the senses become impaired from these occupations, and there is deafness and imperfect vision, so that light becomes extremely painful to the eye. It is unfortunate that this occupation leads often to abuse in the habits of smoking and chewing tobacco. When this occurs, the evil consequences are greatly increased. I believe few workmen escape altogether the dangers I have named. Not many are able to carry on their business beyond the fortieth year.

A long list of diseased conditions are added to industrial pathology under this head. They include:

Giddiness, Nausea or Vomiting, and Faintness; Dyspepsia and Anæmia; Irregular Action of the Heart, Palpitation, Intermittency, and Feebleness; Muscular Unsteadiness and Chest Spasm; Derangements of the Organs of Sense; Impairment of the Senses, of Sight, and of Hearing.

Effects of Obstructing and Irritating Dusts.

The inhalation of carbon in the form of fine powder is a common evil attached to industrial labor. The coal-miners, the carriers of coal, they who are exposed to dense smoke, and they who are exposed to some other occupations, such as walking-stick making, suffer from this irritant. In the miner, the lung may become actually charged with the dust, so as to present, in very extreme examples, the appearance of a carbonized lung; but the carbon, as a rule, is to be considered as less destructive than steel dust, powdered glass, or stone.

The effects of carbon dust are characteristically seen in those who are engaged in charring and shading walking-sticks. The stick having been charred over a coke-fire, the shading is conducted by removing the charred part by means of a fine rasp and sandpaper. An atmosphere of fine particles of dried carbon is produced, and the irritative action of it on the lungs is extreme. In the first stages, the cough is attended with acute suffering, but in time the cough loosens, and if the workman can be relieved of the irritant with the secretion, the acute symptoms give way to a chronic cough. One of these workers, who was greatly reduced by the disease, excited in this manner, told me very simply and clearly the facts in a sentence which I repeat. "It is all right," he said, referring to the charcoal dust, "it is all right when we can cough it up. If a man get that way, he can stand his work for many years; but eventually the cough always masters us, and we break down."

I must reserve details of the major evils arising from the inhalation of carbon, such as the diseases developed in coal-miners, in order to continue the general survey on which we are at this moment engaged.

In some occupations where the burnishing of metallic substances is carried on, much irritation and some obstruction is produced in the bronchial tubes by inhalation of the dust derived from the soft impalpable powder with which the polishing is carried out. The powder of rouge is commonly used for this purpose. The powder is placed on a circular brush, which

is made to turn in a lathe, and as the brush rapidly revolves, an atmosphere of dust is thrown in the face of the worker. The inhalation causes a slight bronchial irritation and the expectoration of a phlegm which is often tinged of a rouge color; but the difficulty I hear most complained of by the workmen is a peculiar oppressiveness and obstruction of breathing which, when it is once experienced, lasts for a long time, and is the cause of an all but persistent chronic cough.

Flour-dust is another of the obstructive as well as irritative dusts, and men who work in flour-mills afford, I think, the most striking illustrations of obstruction of breathing from the inhalation of minute particles of solid matter. The particles of flour produce comparatively but little irritation, but they are carried readily into the bronchial tracts through the minute ramifications of the bronchial surface, and render the breathing irregular through parts of the lung. Thus an irregular pressure of the inspired air is brought about, an undue pressure is exercised upon some portion of the lung structure, there is rupture or break of the minute vesicular structure, and therewith the development of that disease of the lung which is technically called *emphysema*. The symptoms attendant on this condition are those of suffocative breathing and spasmodic cough. They constitute the disease commonly called "miller's asthma."

To the diseases incident to industrial labor, *emphysema*, and the suffocative cough which attends it, may therefore be added.

[Popular Science Review.]

ASTRONOMY.

THE SUN.—According to the Astronomer Royal, the spots at present are fewer than he has ever known. Photography is being applied to them at Greenwich. A valuable series of photographs, comprising more than an entire spot-cycle of eleven years, has been presented to the Astronomical Society by the executors of Professor Selwyn. Padre Secchi has reported his observations from April 23d to June 28th, to the Académie des Sciences. He had been recording, not as formerly, the number, but the area of the spots, which were steadily diminishing, as well as the daily number of protuberances. The more vigorous eruptions ceased as the larger spots disappeared; lofty protuberances had become very rare; those at the pole had greatly decreased; and the faculæ which had formed polar coronæ had vanished; so that, on the whole, we may be passing through a *minimum* of these phenomena.

THE MOON.—The remarkable flattenings of the limb to which the Rev. H. C. Key drew attention twelve years ago were re-observed on November 11th or 12th, to great advantage, by himself, Messrs. Birt, With, and Erck. Mr. Key says that if these two depressions had been repeated all round the limb its form would have been a very decided dodecahedron. The suitable libration had been previously computed by Mr. Marth, but as Mr. With had seen them even more strikingly during the previous lunation, it is evident that they are worth looking for at other epochs. Their interest arises from the fact that they can not be the profile exhibitions of great plains, which would still preserve the general convexity of outline, but must have the effect of concavities as respects the centre of the moon; resembling nothing, at least of any magnitude, in the visible hemisphere: an indication, perhaps, that the formations at the back of the moon may not be entirely similar to those on this side.

MARS.—Dr. Terby, of Louvain, is actively occupied in collecting observations and drawings of this planet. The Observatory at Leyden has purchased the "Areographische Fragmente" in two MS. volumes, left unpublished by Schröter. Kononewitsch suspects a diminution of the planet's brightness. The Astronomer Royal has pointed out the importance of a renewed investigation of the solar parallax from the opposition of Mars in 1877, which he considers preferable to the transits of Venus, and will publish in the Monthly Notices a chart of the stars to be observed with the planet at that epoch.

THE MINOR PLANETS.—Discoveries in this region have been increasing in an unprecedented ratio. No. 150 was detected, October 10th, by Watson, at Ann Arbor. No. 151 by Palisa at Pola (on the Adriatic), November 1st. No. 152 by Paul Henry, at Paris, November 2d. No. 153 by Palisa, November 12th. No. 154 by Prosper Henry, at Paris, November 6th. No. 155 by Palisa, November 8th. No. 156 by Palisa, November 22d. (These numbers are not in order of priority, and probably will have to be rectified.) So rapid a development of our knowledge in this direction, amounting to sixteen during the present year, and six in one month, is likely to cause embarrassment. Computation already begins to be uncertain, and failures frequent in rediscovery.

JUPITER.—M. Flammarion, who has been drawing this planet, has noticed various remarkable changes in the color of the luminous zones, and a number of white elliptic spots, seemingly followed by ill-defined shadows, and terminating in angular trains, as if the shadow passed through separate strata of clouds.—Miss Hirst, of Auckland, New-Zealand, has sent to the Royal Astronomical Society some drawings made with an 8½-inch silvered glass Browning reflector during the opposition of 1875. On one occasion a number of small dark spots with extremely black centres were seen on the S. polar zone; at another time a small oval patch of a decided sea-green for three days near the same pole. Lassell's bright spots were twice observed. It is evident from these and other observations that we are at present far from having attained any consistent interpretation of the phenomena of this colossal planet; and the want of consent among contemporary drawings points to the conclusion that something better must be accomplished in this way before we can make satisfactory progress. The inscription must be more faithfully copied before we can attempt to read it; and probably this will not be done excepting in the use of those commanding instruments, now fortunately becoming more common, in which the size and brightness of the picture will diminish the ratio of personal equation to a much more unimportant fraction than that which now represents it. Dr. Terby may, we hope, be induced to repeat on this most interesting planet the investigation which he has so ably and diligently conducted in the case of Mars.—Le Verrier has investigated the mass afresh, and adopts $\frac{1}{1046{\cdot}77}$ the value given by Airy from observations of the fourth satellite in 1835. This would of course be preferable to the old result, $\frac{1}{1067{\cdot}09}$, obtained by Laplace from Pound's observations; but he finds it superior also to Bouvard's (1824) of $\frac{1}{1070{\cdot}5}$, deduced from the perturbations of Saturn by a method which he discovers to be inexact, but which accidentally led to nearly the same value as Pound's. From Triesnecker's observations in 1794 and 1795, Bessel had brought out $\frac{1}{1055{\cdot}68}$; Nicolai, from fifteen oppositions of Juno, $\frac{1}{1053{\cdot}92}$; Encke, from fourteen oppositions of Vesta, $\frac{1}{1050{\cdot}36}$; Santini had deduced $\frac{1}{1049{\cdot}2}$; Bessel from his own measures, $\frac{1}{1047{\cdot}879}$; Krüger, from the perturbations of Themis, $\frac{1}{1047{\cdot}16}$; Müller, from Faye's comet, $\frac{1}{1047{\cdot}79}$; Von Asten, from that of Encke, $\frac{1}{1047{\cdot}61}$.

SATURN has been very unfavorably situated for English observers; but the position of the satellites has been compared with Marth's ephemerides by Mr. Christie at Greenwich.—Le Verrier has compared his theory of this planet with the observations of the last thirty-two years, and finds the result satisfactory, some slight discrepancies being probably due to the varying aspect of the ring.

URANUS.—Professor Newcomb, who is in charge of the great achromatic at the Washington Observatory, of 26 inches' aperture, has made a special study of the satellites of this body during the early part of this year. He fully confirms Lassell's opinion that there are only four, the orbits of which he finds nearly circular and in the same plane. The brighter satellites, Oberon and Titania, appeared in this noble instrument about equal to fourth magnitude stars with the naked eye; the two inner ones he thinks the most difficult of well-known objects, but was surprised at the precision with which he could bisect them. They were pretty certainly discovered by Lassell, and have not been, he thinks, subsequently seen by any one except himself; they are claimed, however, by the Melbourne reflector. Sir W. Herschel's outer satellites he pronounces non-existent. The feeble perturbation of these minute bodies by each other or by the far-distant sun in the immediate presence of their overpowering primary enables the mass of the latter to be ascertained with considerable exactness, and the Professor deduced a value of $\frac{1}{22600}$. The accurate focusing of the eye-piece was, however, disturbed by the differing color of the redly illuminated micrometer webs and the greenish-yellow satellites, and this may somewhat affect the result. No markings were detected on the disk. It is believed that the two brighter satellites are within the grasp of the larger telescopes in England.

OBSERVATORIES AND INSTRUMENTS.—The Paris Observatory is now opened by Le Verrier's orders three times a week in the evening, weather permitting, and two large telescopes are placed at the disposal of visitors provided with letters of admission, obtained by application to the secretary. This is a move of the most commendable nature, and an example which we should do well to follow. The arrangement of our public observatories might not admit, generally speaking, of such an interruption; but it might be worthy of consideration whether observatories for popular and educational purposes might not be established in our larger cities, provided with sufficient instruments and attendants, the expenses of which might be met by subscriptions and entrance charges.—We regret to find that Mr. Hind's observatory at Twickenham, the 7-inch Dollond achromatic in which did such excellent service at Mr. Bishop's in Regent Park, is to be dismantled, and the instruments presented to the Royal Observatory at Naples.—Winnecke at Strasburg describes a new orbit-sweeper, and announces the commencement of a review of nebulæ.—The observatory of the Rev. H. C. Key, at Stretton, near Hereford, is now in a high state of efficiency, being provided with two 18-inch silvered glass specula, perfect to the edge, one of which is equatorially mounted and driven by clockwork. There is a filar micrometer and apparatus for wire-illumination by galvanic current, and a large and ponderous spectroscope by Browning, with two prisms, of which one only can be used for very faint objects, the collimator lens and object-glass of inspecting telescope having each an aperture of 1¼ inch; there is a tangent-screw micrometer, and filar ditto arranged to throw an illuminated image of the webs across a faint spectrum; besides the usual appliances of transit, clocks, etc.—Mr. Lockyer and Major Festing have been sent by the English Government to Rome, with the object of borrowing from the Italian Government a collection of interesting astronomical instruments, to be exhibited next year at South Kensington.—Mr. Lick, it is said, has selected Mount Hamilton, in Santa Clara County, California, 4448 feet high, with no rival within fifty miles, as the site for the "million-dollar telescope."—The largest achromatic ever made will shortly be in progress at Mr. Grubb's new factory near Dublin. The aperture will be 26 inches, or 27 if the disks, which are the production of M. Feil, of Paris, will admit of it. It is intended for the grand new observatory at Vienna, and will probably not be finished before 1878.—A 12¼-inch object-glass by Grubb has recently been mounted at the new Observatory at Oxford.—Feil's glass, which seems likely to supersede that of English manufacture, not now as successful as in past years, has been already tried and approved by Wray.—Alvan Clark, it is said, has received an order from the Austrian Government for an immense reflector, to be placed in a new observatory at Trieste. (For "reflector" we should probably read "achromatic," though we have heard that specula occupied the earliest attention of that great optician.)—The new great reflector at the Paris Observatory is said to turn out very satisfactorily. The movable part weighs nine tons, the speculum of silvered glass half a ton, its diameter being 120 centimetres (47¼ inches), and focal length 6·8 metres (22 ft. 4 in.) The front view has been adopted. It is said to give good definition of minute stars; though we may be pardoned for suggesting that if it was finished by the method of retouching devised by Léon Foucault, its figure is hardly likely to equal those worked by the direct process adopted by the most eminent makers in England. This magnificent instrument, which is protected, when not in use, by a gigantic iron cover, movable on rails, has been six years in construction, at an expense of 8000*l*., of which one quarter was absorbed in the speculum alone. Our neighbors, in the midst of their political difficulties and social distresses, have shown a noble example of scientific munificence, which we earnestly desire to see followed among ourselves, and we cordially wish the new telescope success.

THE NEW OBSERVATORY AT VIENNA.

A LETTER from Dr. de La Rue to the Royal Astronomical Society gives interesting details concerning the new Observatory at Vienna. The old one is situated among the busy streets of that city; it was founded in 1753, and rebuilt in 1826–27; but its site renders it at present quite unfit for accurate astronomical work. M. von Littrow, the Director, urged the need of a new site and another building upon the Austrian Government, and Prof. Weiss visited the public and private observatories of England and this country before the new plans were decided on. It was at length concluded to have a refracting telescope of the largest size—26 inches aperture; and the starting-point of construction, the dome of the observatory, will therefore have 42 feet internal diameter. The site chosen is three miles north of the centre of the city and 200 feet above its mean level. The new building will be 330 feet long (north-south) and 240 feet deep (east-west). The foundation was laid in June, 1874; the structure is expected to be complete in 1877. The dwelling of the Director and apartments for his assistants are included in the building. Dr. de La Rue thinks this arrangement unwise, as the heated air from such sources will be likely to interfere with the use of the instruments. These dwelling-rooms, the library, lecture-room, offices, and entrance-hall take up the long arm of a cross which is the ground plan of the building. The great dome is at the intersection of the arms of the cross, and three smaller domes will be placed on the shorter extremities. The large equatorial for the central dome has been ordered of Mr. Howard Grubb, of Dublin, and a 12-inch refractor for one of the smaller domes, of Mr. Alvan Clark, of Cambridge, Mass. The latter instrument is to be mainly used to determine the positions of small planets and comets. An equatorial reflector specially adapted to photography, a prime vertical instrument, and an altazimuth or a heliometer, will also probably be ordered. It will be noticed that Austria means to keep up with the advancing needs of science as to the new physical branches of astronomy, as well as in the older methods of research.

HORTICULTURAL FRAUDS.

AT a recent meeting of the New-York Horticultural Society, Mr. William Elliott, of New-York, called attention to the species of plant swindling which had been carried on for years past in certain localities on Broadway, and which it behooved the honest members of the profession to put a stop to. A few days ago he called, in company with a brother member, at a shop kept by a foreigner, and asked to see his latest novelties. He was shown a "strawberry-tree," and was told that the fruit produced on it was almost as large as a man's fist, and of a flavor equal to the best cultivated strawberry. Rose plants, which the French dealer affirmed would grow striped, scarlet, yellow, black, and blue roses, of nearly six inches diameter, were offered at ridiculously low prices. Asparagus, which ordinarily takes three years to mature, was sold at the same place, warranted to produce a crop within six weeks. Seeds of this vigorous plant, which usually retail at fifty cents per pound, were offered by these Continental horticulturists at five cents apiece, or over one hundred dollars a pound. The gladiolus, which is known to horticulturists only in pink and white, is offered for sale by these enterprising gentlemen, in blue. A blue gladiolus, a plant never before recorded, would be worth $1000 as a mere curiosity, and yet these French and German dealers on Broadway were selling plants which they termed "blue gladiolus," at $1 a piece. Another member said that a notorious "firm" of this character, which was conducted by Hollanders, employed an interpreter to translate the unheard-of merits of their wonderful plants into vulgar English for the benefit of customers. Thousands of dollars were taken from the community in this manner. Another member mentioned the name of a highly prominent merchant who bought at one purchase $700 worth of these worthless plants. These firms usually changed their names and places of business every year, but they were readily to be recognized. Would-be purchasers were shown first the unplanted slips and then a book containing pictures of the full-blown "blue roses" and "strawberry-trees," and assured that such a thing as a failure to come to maturity in the manner promised was unknown. The workings of this fraternity were pretty thoroughly exposed several years since in a weekly journal of this city, and resulted in killing the business for the time being, but with the lapse of public memory the trade had revived to its old proportions. On motion, a committee of five was appointed by the President to examine into the matter, and ask of Mayor Wickham that respectable horticulturists and the public be protected against this species of imposition. After transacting some further business, the Society adjourned.—*Times.*

NEW PLANTS FROM THE NICOBAR AND ANDAMAN ISLANDS.

HERR S. KURTZ, in the *Journal of Botany*, says that the interest which attaches to the Nicobar vegetation rests chiefly in the peculiar polycistine clay, which looks somewhat like meerschaum, and is also nearly as light and porous. This clay covers large areas on those islands which form the so-called northern group. It contains, according to Dr. Rink's analysis

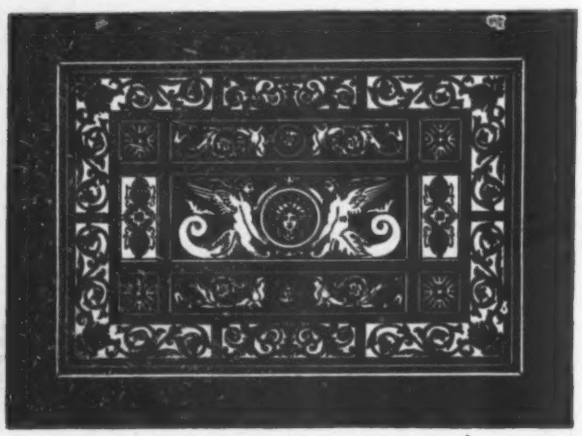
Silica	72·2
Oxide of iron	8·3
Alumina	12·3
Magnesia	2·1
Water	5·6
	100·5

Here the total absence of alkalies is very remarkable. In places it becomes red from abundance of oxide of iron, and in this case it is usually literally filled with fossil seaweeds. A microscopical examination of the rock reveals abundance of silica, fragments of polycistines, and diatoms. One would say that on such substrata nothing but wretched scrub and harsh grasses could vegetate; but an examination of the greater part of Kamorta has taught me that luxuriant tropical forests, with an average height of about 80 ft., not only cover the seaside, but the same forests form belts of considerable breadth over the island itself, while the inner hill plateau is covered by those peculiar park-like grasslands which Dr. Diedrichsen has called grass-heaths. The next rocks botanically influential are calcareous sea-sand, raised coral-banks, limestone, and calcareous sandstones, which belong to the so-called southern group, in which, however, Katchall (an entirely calcareous island) is enumerated. Then come the plutonic rocks and their *detritus*, which, however, were only little developed in those parts which I visited. All islands consisting of the above rocks are characterized by the absence of grass-heaths, and are covered with forests from the bottom to the top. The four principal aspects of vegetation in these islands are: 1, mangrove swamps; 2, beach forests; 3, tropical forests, which fall under three groups, those growing on polycistine clay, those on calcareous or coralline strata, and those growing on plutonic formations; 4, grass-heaths.

IMITATION OF INLAID WOODS.

By SPURR & PRANG, Boston, Mass.

WE take a thin veneer of light or white wood, and fix on one side of it, by a paste or cement, a backing of paper. The thin wooden veneer we previously subject to the action of an acid solution (which may be composed of one part oxalic acid to nine parts water, or thereabout) by dipping the wood therein or thoroughly washing its surface or surfaces therewith, after which the wood should be slowly dried. Next, we wash with a solution of glycerine (which may consist of one part glycerine to four parts water) that surface of the veneer which is to be printed or to receive the design in imitation of marquetry or inlaid work, which having done we subject the veneer to a process of slow desiccation, after which we rub the surface down with sandpaper or pumice to smooth it or remove from it all extraneous fibres or matters, and next print or paint upon it a black or colored background, and the figure or figures to represent inlaid work, as shown, or in accordance with any suitable design. After the ink color or colors so applied to the wood may have become set or dry, we cover the surface with a weak alcoholic solution of shellac, or a thin varnish, to prevent the colors from being rubbed off in the process of fixing by glue the sheet to a piece of furniture. The article is then ready for use. In using it, it is to be fixed to a surface, as a sheet of veneer usually is, by means of glue.



IMITATION OF INLAID WOODS.

With the article so produced, an excellent and remarkably close imitation of marquetry or inlaid work, especially of wood, ivory, or bone, may be accomplished at a trifling expense, in comparison to that required to produce the real work, of which the article may be an imitation.

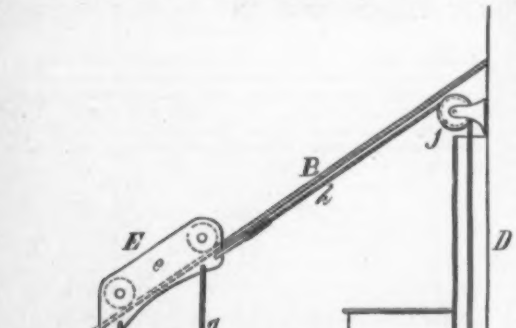
In making veneering, the wood being damp when cut, is very liable to become and usually is stained more or less, particularly by the knife. By employing an acid solution, as hereinbefore set forth, the natural as well as the artificial stains are mostly if not entirely removed. When the wood has to be rendered whiter, a bleaching material, such as chloride of lime, may be applied to it, but, generally speaking, the acid solution will suffice. The wood after, as well as before, such treatment, is more or less wrinkled or cockled. In order to remove the wrinkles or cockles, or unevenness, and prepare the surface for receiving the imprint or colors, we make use of glycerine, as hereinbefore mentioned.

The backing of paper not only prevents the wood from splitting, but enables the fortified veneer to be strongly affixed to a surface by glue, without the latter striking through the wood to the injury of the design or figure thereon.

PASSENGER ELEVATOR FOR DWELLINGS.

By G. R. POTTER, Buffalo, N. Y.

A, FLIGHT of stairs; B, inclined rail, rod, or cable, arranged at one side the stairs, with its ends to the floor C and wall D. E, movable carriage running on the rail B. G, seat, attached to carriage E by means of rods or hangers, *g*, the carriage being above the rail and the seat below the same. A cord attached to carriage, passing over a sheave or guide-roller, *j*, and connecting with a weight, H, so adjusted as to be somewhat in excess of the average load to be raised.



PASSENGER ELEVATOR FOR DWELLINGS.

ARTIFICIAL PEARLS.

IT was about the seventeenth century that it was tried with more or less success to imitate real pearls, and the most successful means to which recourse was had was with the aid of the "Oriental essence," or a pearly-white solution from the scales of the bleak, called guanine. In giving to this product the name "Oriental essence," it was with the intention of keeping the substance secret. In Anjou, although this industry (that is to say, the bleak fishery to obtain the "Oriental essence") is little known, it is no less certain that the fishermen of Ecoufflans and Ponts-de-Cé largely aid the manufacture of imitation pearls, and that they still use this name, or that of bleak white. The scale of the bleak is lubricated by a mucus which was for a long time considered albuminous, but it is not so. This essence is very abundant, and is difficult to mix with water. It coagulates by heat to a thick white deposit, and becomes black in time if a proper remedy be not applied to prevent this deterioration, especially during the time of intense heat, during which period fishing is at its height in the Loire and the Mayenne. If the scales of the bleak are examined under the microscope, the smallest are found to be nearly round; and if the surface of one of the larger ones is lightly pressed, this "Oriental essence," under the form of a small pearly drop, issues from one of the canals and sticks to the fingers. In this mucilage an infinite number of small, rudimental, pearly scales can be seen. The largest scales are square, nearly rectangular, four times as long as they are wide; each scale has three colorless cylindrical veins. It is to M. Jaquin that this invention is due, all the more fortunate as it remedied the difficulties and bad effects of the pearls made of quicksilver placed in a glass bulb. In Anjou, in order to obtain this "Oriental essence," they only fish for the bleak; however, the scales of the dace furnish it also. The bleak (*Leuciscus alburnus*) is the only river fish which is not used for food; it is a white fish, well known in the running streams and on the flat, sandy coasts of France, where the water is not deep; it is also found in the Seine, Marne, Moselle, Escaut, etc., never descending into the Black Sea, being principally found at the mouth of rivers. In Anjou they spawn on the sand in the months of May and June. For its propagation in certain parts of France, artificial spawning-places are made by the aid of heaps of sand where they multiply. In Anjou, recourse is not had to any artificial means; they breed under the shelter of the flat, sandy coast, thus avoiding becoming the prey of other fishes.

The fishermen use a mesh net, and catch the bleak by thousands as they travel in shoals in the current, taking care not to let them get entangled in the meshes, or wound themselves, or lose a part of their large scales; but, above all, not to stain themselves with blood. The following is the process of extracting the "Oriental essence:" Men and children, provided with blunt knives, take the fish one after the other and scrape them over a shallow tub, containing a little fresh water. Care is taken not to scale the black or the dorsal part, as these scales are yellow, while the white scales are very valuable. The whole is received on a horsehair sieve. The first water, mixed with a little blood, is thrown away. The scales are then washed and pressed; the essence settles at the bottom of the tub, and it is then that we have a very brilliant, blue-white, oily mass. Warm water must not be used for the washing, as it would promote fermentation. It takes 40,000 bleaks to furnish two pounds of essence. The fishermen put this guanine in tin boxes, which they fill up with ammonia; the box is then closed and sent to Paris. Others prefer to put it in large-mouthed bottles. If a drop of the essence is taken up by a straw and let fall upon water, the guanine floats, giving forth the most brilliant colors. The intestines of the bleak are thrown away. They are, however, covered with this mucus. There is here great negligence, and, in spite of all the advice given on the subject, the fishermen lose a large part of the produce. This guanine is insoluble in water, in ammonia, and in acetic acid, but combines with sulphuric and other acids. We know that the pancreas also furnishes this substance. There is no doubt that they are wrong to neglect that which covers the intestines. Although the yield would be small for each fish, it is none the less true that large quantities could be so obtained.—*M. Menieres (Angers), Journal of Applied Sciences.*

GIVING MEDICINES TO THE MOTHER FOR THE SUCKLING INFANT.

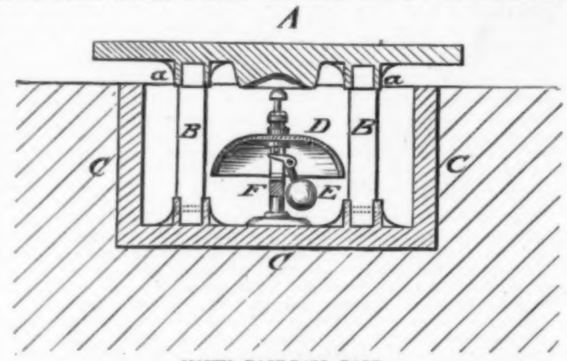
DR. LEWALD has, says the *Lyon Medicale*, investigated the elimination, by the milk of the mother, of iron, bismuth, iodine and its compounds, arsenic, lead, zinc, antimony, mercury, alcohol, and several narcotics. His numerous experiments were made in the goat. A certain dose of the medicine was administered to the animal, after which the milk was examined. The principal conclusions which the author has arrived at are: 1. A larger quantity of iron can be administered to the infant through the mother's milk than by any other means. 2. Bismuth likewise is eliminated by the milk, but in very small quantity. 3. Iodine does not appear in the milk until ninety-six hours after taking it; the iodide of potassium given in doses of forty grains per diem appears four hours after ingestion, and continues to be eliminated for eleven days. 4. Arsenic appears in the milk at the end of seventeen hours, and its elimination had not ceased after sixty hours. 5. Though one of the most insoluble preparations, the oxide of zinc is nevertheless eliminated by the milk, and it is probable that this is also the case with the other preparations of zinc; fifteen grains of oxide of zinc were found in the milk at the end of from four to eight hours, and it disappears sooner than iron, because no trace of it could be discovered after fifteen or sixteen hours. 6. The elimination of antimony is an undeniable fact, and it is well to bear this in mind during the period of nursing; the same holds true in regard to mercurial preparations. 7. That alcohol and the narcotics are eliminated by the milk has not been demonstrated. Sulphate of quinine is eliminated very easily; a child suffering from intermittent fever was cured by administering quinine to the nurse.

NOVEL BASE-BALL BASE.

By J. C. O'NEILL, St. Louis, Mo.

THE invention consists of a case or box, which announces, by contact with a bell, electrical contrivance, or other device, the exact moment in which the cap is depressed. The touching of the base by the runner is thus clearly announced to the umpire, who is enabled to render his decision in a perfectly correct and reliable manner, avoiding thereby the dissatisfaction and squabbles arising from erroneous observations and decisions.

A, the cap or platform, which is cast with sockets *a* at the under side, that fit on upright supporting-columns B, of rubber or other elastic material of suitable thickness, but of sufficient elasticity to be depressed when the foot of the runner touches thereon. The columns B are set into similar



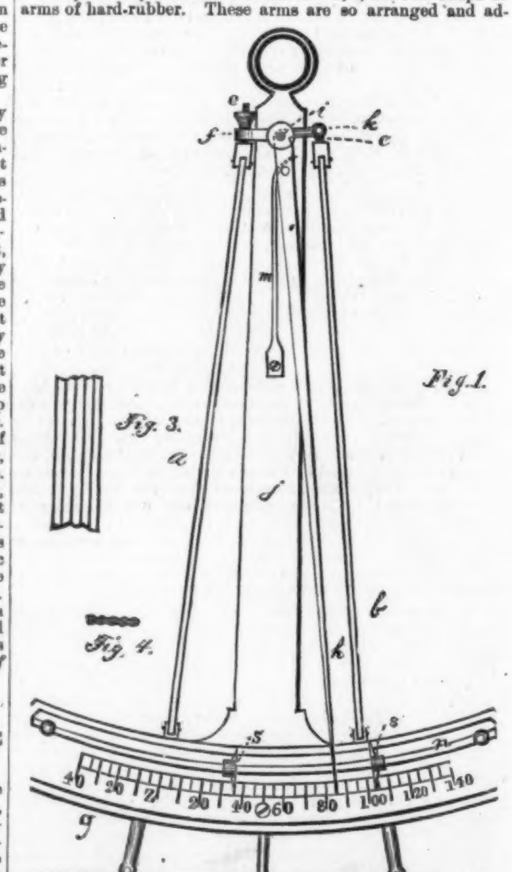
NOVEL BASE-BALL BASE.

sockets of a base-box C, which is set into the ground, allowing the cap to project above the same. The box is also cast of suitable metal, and arranged, further, with a bell mechanism, D, that is mounted on a post, F, and actuated by the contact of the cap with the sliding top button, operating clapper E.

IMPROVEMENT IN THERMOMETERS.

By G. W. SCHUMACHER, Portland, Me.

A REGISTERING-THERMOMETER operated by the contractile and expansive power of hard-rubber. *a*, *b*, are two strips or arms of hard-rubber. These arms are so arranged and adjusted that one of them is permitted to expand and contract in such way as to move levers attached at both ends of another arm, by which movement the operations of the instrument are effected.



IMPROVEMENT IN THERMOMETERS.

The arm *b* has attached to it two levers, *c* and *d*. The arm

s is fixed at its upper end by means of a set-screw, e, working in a screw-hole in the piece f, g is the plate containing the register or scale, and upon which are marked off the different degrees. h is the finger or indicator, which at its lower end points out upon the scale the different degrees of temperature as it is moved by the contraction and expansion produced by heat or cold. The indicator h is rigidly attached to a small sleeve surrounding a small stud or pin, i, which stud or pin is inserted into a back-plate, j. The indicator h and the short lever k are both rigidly attached to the sleeve. As the rubber arm a contracts or expands it moves the lever d upon its pivot l. The long arm of this lever is attached to the lower end of the arm b, which arm at its upper end, as before specified, is attached to the lever k. Thus the movement at the end of the lever d, where it is connected with the rubber arm b, is increased from that produced on the short arm of this lever, where it is connected with the arm a, in proportion as the long arm is longer than the short one. This movement is also assisted by the contraction and expansion of the arm b. The movement of the indicator, produced by the contraction of the arm a, is such as to show on the registering-plate low degrees of temperature, and the other movement higher ones. The use of the set-screw e is to place the point of the indicator at the proper degree on the registering-plate when the thermometer is adjusted for actual use. This may be done by obtaining the correct degree from a reliable standard, both instruments being at the same temperature. m is a spring, bearing upon the indicator h, and tending to move the same upwardly on the scale of the registering-plate. When the arm a, with its other arm b, are subjected to cold, and contracted, they move the indicator downwardly on the scale and against the force of the spring m. When the arms are expanded by warmth the spring m moves the indicator upwardly on the scale as far as it is permitted to do by said expansion. On the front of the registering-plate is set a curved rod, n, or any equivalent device. This is to receive two movable pointers, which are impelled on the rod or track by the indicator h. The purpose of these two pointers is to record extremes of temperature during an interval of time in which the thermometer may not have been consulted, or if the change of temperature is only in one direction, to show the difference between the time when the registering-plate was last examined and some other time when an examination is intended to be made. These devices will of course remain at the extreme points to which they are pushed by the indicator. The arms a and b are corrugated in order to expose to the action of the temperature of the air the largest possible amount of surface. When exposed to cold the contraction of the arms, acting upon the levers, as described, causes the indicator so to move along the scale as to indicate the proper low degree of temperature, and heat or warmth, and the consequent expansion permits the spring m to operate the indicator to such an extent as will show the proper opposite degree of temperature. The spring m also serves to maintain a proper strain upon the different parts of the thermometer and prevent "play" of the same, so as to insure as nearly as may be an exact operation. s s show the pointers.

[Engineer.]

IMPROVED UNIVERSAL LATHE.

THE engraving shows a universal lathe designed by Mr. Koch, manager of the technical office of the machine administration of the Cologne-Minden Railway, and by Mr. H. Müller, foreman, Dortmund, to whom we are indebted for the following description: This lathe, patented in Prussia, under the name of Passig Drehbank, is furnished with two mandrils, W and W, the latter revolving in the first one. As will be seen from the engraving, the cone-pulley R receiving the first motion drives the external mandril W. The toothed wheels Z, Z′, Z″, and Z‴ form the usual lathe gearing, and both the toothed wheels Z Z′ drive a shaft w, to the end of which is fixed a toothed wheel Z″ gearing with the toothed wheel Z‴ attached to the internal mandril W′. By changing the toothed wheels Z″ and Z‴ in size, any proportion of the number of revolutions of the internal mandril W′ and of the external mandril may be produced.

A disk E fixed to the internal mandril may be eccentrically adjusted on it; on this disk moves the face-plate on which the objects to be turned are fixed; a driver M attached to the external mandril causes this face-plate to rotate.

The mode of operation in this lathe is easily to be understood. As shown in the engraving, the toothed wheel Z‴ is of half the size of the wheel Z″, therefore the eccentric disk E and the mandril W′ turn twice—that is, the object to be shaped is twice approached to the chisel and twice withdrawn from it, and yet makes one revolution only with the face-plate by means of the driver. The shape of the object to be worked will be that shown in Fig. 4 or 4ª, in proportion to the eccentricity of the position of the disk E on the shaft W′. In changing the wheels Z″ and Z‴ with those of threefold, fourfold, or higher velocity ratios, the figures 5, 6, 7, etc., will be produced. If the head of the screw S, which connects the disk E with the shaft W′, and prevents at the same time the face-plate P from sliding away, has been conveniently shaped, it may be used as a common centre for turning shafts in the usual manner.

If shafts are to be turned, a second headstock instead of the puppet is to be applied to the lathe; but in this case the headstock is provided with one mandril only, arranged in the manner shown in W′ without the face-plate P. The head V of the external mandril W is purposed to bear a wheel not shown in the drawing, by means of which the self-motion of the slide-rest is produced in the usual manner.

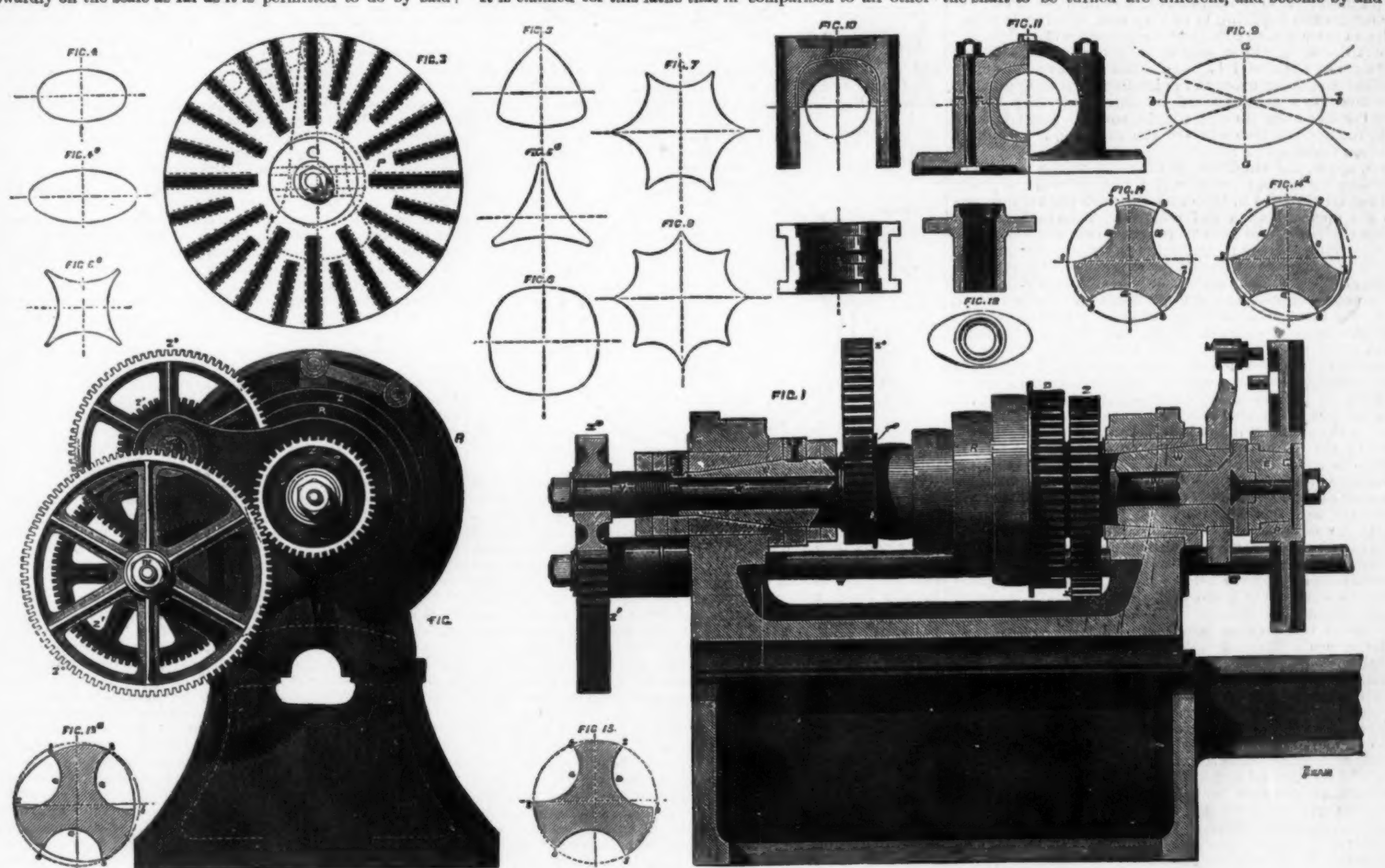
It is claimed for this lathe that in comparison to all other known oval lathes it has the great advantage that the position of the chisel is always more favorable. For instance, the positions of the chisel when cutting an ellipse may be seen from Fig. 9, the dotted lines showing the position of the chisel in the common pattern lathe and the continuous lines showing the position of the same in the new lathe. Another difference between this and other lathes is that the chisel cuts much more slowly at b than at a. As to the working of metals as well as of wood, it is to be expected that this lathe can be put to great practical use as soon as the engineers are accustomed to the application of the new forms, which it has been hitherto impossible to make without great expense. Here we can show this use but in a few cases. In Figs. 10 and 11 a locomotive axle-box and a common journal-box are shown. By means of this lathe both the blocks as well as the corresponding bushes may be turned on the face-plate without any fitting of these parts by hand. If the disk E of the lathe before the head of the shaft W′ is adjusted by means of an endless screw in the same manner as a slide-rest is put in motion, the bushes may be finished on the face-plate. If locomotive connecting-rods and coupling-rods are made of an oval cross-section instead of the usual square one, their execution will be much cheaper, and with respect to their power of resistance their parts will be of a much more rational and advantageous form.

In fixing cranks, pulleys, or wheels on shafts, the use of keys may, it is claimed, be dispensed with if the shaft has a square cross-section, easily made by adjusting the disk E slightly eccentrically. If the disk E and the shaft W′ are slightly eccentric, made in one piece, there is, it is said, no doubt that the work by means of this lathe is sufficiently exact to allow the fitting of locomotive-wheels on their axles without any wedges.

The shaft W′ in the second headstock being prevented from rotating, the figure turned to the other side becomes gradually a circle. If in this arrangement the centre of the shaft W′ is withdrawn from the chisel to a distance half the eccentricity of the disk E with reference to the shaft W′ of the first headstock, the diameter of the circle to be produced is as long as the longest diameter of the figure turned to this side. The forms produced in this way are particularly useful in the manufacture of rimers and screw-taps. In Figs. 13 and 13ª cross-sections of rimers are shown as made till now, and as they may be made by means of the new lathe. In making a rimer—Fig. 13—at first the cavities a are cut in the round bar shown in dotted lines, and afterwards the parts b are shaped in the shown form by means of a file by hand. This latter part of the work must be executed with the greatest care, and can not be done but by the most clever workman if the rimer shall satisfy its purpose. One awkward stroke of the file applied to the edge pushes it behind one part of the surface and prevents thereby the tool from cutting. In making by means of the lathe the triangular cross-section of the tool—the dotted circle is only made in order to show better the triangular form—it is only necessary to cut away the parts a and the file is entirely dispensed with. The operation of milling by means of this lathe may be executed also by increasing the eccentricity of the disk E, and by withdrawing the chisel. If the triangular cross-section of the rimer as shown in the drawing becomes by and by a circle, it fits more and more perfectly the hole to be made, and after it has passed through it the hole is exactly circular. As to the screw-taps, Fig. 14 and 14ª, the same remark as to the rimer may be made, but the screw-tap made by means of the lathe has the eminent advantage that not only the point of the thread b, but the basis also is behind the cutting edge s, which is not the case in screw-taps made otherwise.

If the number of teeth of the wheel Z″ and Z‴ are not in the precise proportion from 1 : 2, 1 : 3, 1 : 4, and the figures to be produced run in screw lines around the shaft, and if the number of revolutions of the shaft W′ of both the headstocks are different, the figures of the cross-sections at both sides of the shaft to be turned are different, and become by and by the same. If the wheels Z and Z′ be different in size, and the wheels Z″ and Z‴ elliptic, other and remarkable figures are produced. Hereby it may be seen that it is very easy to produce many new, useful, and complicated forms which are doubtless of greatest advantage in architecture, cabinet-making, in the manufacture of umbrellas, walking-sticks, etc. The driver turning on a fixed point, and the face-plate on a pivot, the centre of which moves in a circle, the circular velocity of the face-plate is not perfectly uniform, and the figures are symmetrical with reference only to a line passing the centre. The irregularity of the figures is only remarkable if the eccentricity in comparison with the length of the driver be very great. If the number of revolutions of both the mandrils be in the proportion of 1 : 2, figures are produced, which, according to the angle formed by the driver and the eccentric pointing straight upwards, are egg-shaped and become gradually oval, one half being narrower than the other. If, instead of connecting the pivot of the face-plate with the pivot of the driver by means of a movable crank, the pivot of the driver be made to press against a projecting rim of the face-plate, it would slide to and fro on this rim double the eccentricity for each revolution of the face-plate. The figures thus produced are like those described already. If the said rim is not rectilinear and radial, it is possible, though in narrow limits only, to turn any forms. In increasing the number of drivers and rims of the face-plate, the circular velocity can be made uniform to any degree, even with short drivers.

If in the arrangement of the lathe as shown in the drawing, the pivot of the driver be movable in the latter, the circular velocity of the face-plate in its several positions can be increased or reduced by means of adjusting the pivot of the driver, and thereby it is possible to produce prescribed figures within more enlarged limits than in the above arrangement. If the eccentricity in the position of the disk E be still greater than in the Figs. 2ª, 3ª, 4, and 5, loops are formed in the corners, and the chisel does not cut continually. The bars thus turned have sharp edges, and the chisel always preserves the most favorable position.



UNIVERSAL LATHE; DESIGN OF KOCH AND MULLER.

THE ALTERATION IN THE FORM OF MACHINE WORK DURING ITS MANIPULATION.

By Joshua Rose.

The alteration of form which takes place in a piece of either cast or forged metal during and after its manipulation, is sufficient in degree to be appreciable in even small work, so that it is a well-understood fact that on all work in which it is convenient to do so, all parts should be roughed out by having the surface removed by a roughing cut before any one part is finished, otherwise the work will not, when finished, be true. The causes of this alteration of form are, in the case of castings, due partly to the tension which takes place on the whole exterior of the casting during the process of cooling, and partly from the excess of tension which takes place upon those parts of the casting which are the longest in cooling. The difference in the time required to cool a casting depends upon the relative thickness of one part as compared to another, the freedom of access to the air, and the position in which the casting lies while losing its heat, nor is it practicable to so cool a casting as to make its surface-tension equal all over. If a casting is allowed to cool off in the sand, its surface-tension will be less than if extracted from the mould and permitted to cool in the open air, while, if after the casting has become cold, it is reheated to a low red heat, the tension referred to will be considerably reduced, though not altogether removed. To thus reheat large castings is, however, impracticable, and they should be left to cool in the mould, while those extracted from the moulds while hot should be put in some convenient place in the foundry and covered with sand.

In addition to the above tension, many pieces of work are sprung by the pressure of the clamps by which they are fastened (in machines) to be operated on, and in all work of a delicate nature and requiring to be very true, this fact is recognized, and extra feet or chucking-pieces are provided whereby to chuck the work. In stouter work, however, the thickness or strength of the metal is often relied upon as sufficient to withstand the pressure due to the holding-clamps, unmindful of the fact that a piece of metal, no matter how thick it may be, will deflect from its own weight, and the result is work which, though cut true while in the machine, is no longer true when taken out of it.

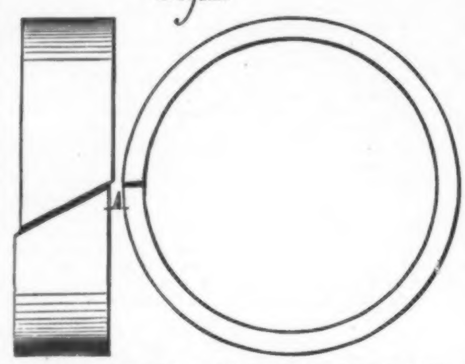
Then, again, the alteration of form due to the removal of the tension on certain surfaces of a piece of work is oftentimes entirely ignored in the order in which the various surfaces are operated upon and removed. Thus in the case of engine-cylinders. The bore is roughed out, and very often finished before the end faces for the cylinder-covers are operated upon, whereas both should be roughed out before either is finished. And it is almost a universal practice to finish the bore and end faces of a cylinder before the flanges which bed to the frame and before the slide-valve face and steam-chest seat faces are planed. Now, the bore of a cylinder should, of all other parts, be when finished true, because, independent of the question of steam economy, it being the longest working surface, a want of truth will be more appreciably felt in it than in any other part; thus supposing the valve-face was out of true to an amount equal to $\frac{1}{16}$ in. in the length of the cylinder, it would be scarcely practically appreciable in the length of its face. Or suppose the face to receive the steam-chest was $\frac{1}{16}$ out of true in the length of the cylinder, the consequences would not be very material, besides which the error would be very easily remediable. Not so, however, with the bore of the cylinder—that would have to pass as it was or be re-bored. The alteration in form takes place in the order in which the tension is removed, so that the last surface operated upon is invariably the most true one. It is obvious then that were all the planing done to a cylinder before the boring was performed, the bore would be much truer than under the present system, because the tension on the whole of the surfaces which are intended to be cut off will have been removed previous to taking the finishing cut through the bore.

That the alteration in the bore of cylinders is appreciably experienced is evidenced by the fact that many engine-builders leave the tool-marks plainly sensible both to the eye and the touch, claiming that after a little working the piston will fit more true and closely to the cylinder than it would were the cylinder-bore quite smooth. And in cases in which much planing has been done to the cylinders after being bored, this is undoubtedly the case, because the wearing surface on the bore of the cylinder is reduced, and hence the tight places or spots wear off more rapidly. Now, let us take the case of slide-valves, which, being of awkward shape to hold, are very apt to spring in the chucking; this part of the subject, however, it is not our purpose to discuss; hence to proceed.

There are two methods adopted to get up slide-valves—one being to get them up to a surface-plate, and the other being to place them so that the tool-marks will be plainly discernible to both the eye and the sense of touch, and to let the planing-marks on the face of the valve run in such a direction that when the valve is upon its seat in the cylinder, the planing-marks on the valve will run at right angles to the planing-marks on the face of the seat. The advocates of this plan claim that after the engine has run a short time, the valve will be a better fit than if both the valve and the seat had been surfaced to a surface-plate; and this is no doubt true in all cases in which, either from excessive inequality in the cooling or from an unusually large amount of metal having been taken off the face of the valve, the tension is considerably removed; for in such case, as soon as the valve becomes heated by the steam, it rearranges its form to suit the altered conditions of the strains upon its surfaces; and here, again, the wearing surfaces being reduced in consequence of the tops only of the planer-marks bearing, those tops will wear rapidly away and let the valve down to a bearing all over quicker than would be the case if the surfaces being smooth there was a greater amount of wearing surface confined within an equal amount of diametrical area. On the other hand, it is undoubtedly true that a valve should from the first bed all over its surface, so as to present a smooth and even wearing surface and to be steam-tight. This, however, can not be insured by simply scraping the two surfaces, and the proper course lies in first planing up the valve wherever it is necessary, and in then re-heating it to about the temperature of the steam under which it is to operate, so that the reformation (of the valve) due to the tension on the planed surfaces having been removed, will take place before the face of the valve has been surfaced to the surface-plate. It is sufficient for ordinary practice to place the valve in boiling water, but if great exactness is required, it should be heated to the temperature of the steam under which it is to operate; and in this latter case, another element must be considered, which is, that the inequality of amount of surface on the face as compared to the back of the valve, and the consequent inequality of the expansion of the valve, due to its being heated, renders it a still more perfect process to heat the valve to its working temperature every time it is, during the process of fitting to its seat, tried upon its seat-surface.

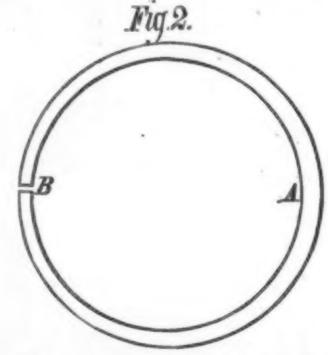
There is probably, however, no instance in which the tension referred to is so sensibly experienced nor so expensive to rectify as in the case of piston-rings. The usual method of making these rings is to cast a ring deep enough to cut the required number out of, and to cast feet on one end of it whereby to chuck it without springing it out of round. In a majority of cases the internal surface or bore of the ring is not trued up in the lathe; the outside being turned true and the end face being trued, each ring is cut off, thus having three turned and true surfaces. So soon as the ring is split, however, as it requires to be, it springs out of true, as shown in Fig. 1, the split being shown at A, the result being a tedious

Fig. 1.



and expensive amount of filing and scraping to bring the sides of the ring fair and true again. In rings such as shown in Fig. 2, the side A being left thicker than the side B

Fig. 2.



where the split is placed, so that, in springing, the ends at B will spring more easily and allow the sides of the ring to fit more easily and uniformly to the cylinder, the spring sideways and out of true after splitting the ring is generally experienced to a greater degree, owing to one side of the ring cooling more readily than the other. The remedy in both cases is to bore out the inside as well as turning the outside of the ring, and to take about as much metal off the inside as off the outside, for even that will make a difference, and in very large rings it will pay to light a wood-fire around them and reheat them, letting them cool off in the embers, and covering them with sawdust and sand mixed, added after the rings are barely red-hot, placing a slightly thicker layer on the thin side of the ring. In forgings, the same surface-tension takes place, the alteration of forms being less, it is true, but nevertheless appreciable. In this case, however, there is no doubt but that it is more the working of the metal at different temperatures and to a varying degree which is the cause, than is the unequal cooling of the surface of the forging. It is impossible for a blacksmith to keep this work at an even temperature all over or to deliver the blows equal in force to all parts of the job; while the metal worked the coldest has the greater tension on it, and that receiving the heavier blows has, supposing the temperature to be equal, the greater tension on it. The effects upon forgings may be instanced in several ways; for example, if a tap is forged—heated to a red heat, and allowed to cool, and is afterwards turned, it will in all probability warp in the hardening, unless it is heated after the outer skin has been burned off it all over—that is, after the tap has been completely roughed out. The centres of a lathe may be turned up as true as possible, the work may be centre-drilled, the ends trued up and properly countersunk, the work may be run a considerable time in the lathe at a fast speed, and turned end for end so as to insure that the centres of the work have become properly bedded to those of the lathe, and yet if the work, say a piston-rod, be turned up half its length, and then, after being reversed in the lathe, the other half be turned up, the one half will not be true with the other. In fact, under the most careful of manipulation and with the best of tools, we can not bore and turn over a common double eye and single eye, and make the two fit evenly and fair one with the other, so that the bolt shall pass through a good fit in both without springing either, and we are compelled, after fitting the double eye, to take a hand reamer and pass through the hole while the two are together to make a practically perfect fit. We may take an eccentric strap, put together in two halves, properly surfaced and fitted together, and composed either of wrought-iron, cast-iron, or brass, and under ordinary careful and commercially practicable manipulation, we can not bore such a strap to either fit a cylinder of its size or so that the two halves shall be equal in diameter across the joint when taken apart. Properly conducted experiments would probably show that in many instances, such, for instance, as in the case of locomotive slide-valves, a practical difference would be found in the manner of cooling the valve after being cast, for if the wearing face be uppermost, the crystals of the iron will lie at right angles to it, since the crystals lie lengthways in the direction in which the heat passes off, and though the heat will pass off from all the surfaces, yet it will pass off most readily from the surfaces most exposed or most readily cooled, and it is as yet an unsolved problem as to what alteration in the crystal formation of the iron may be induced by either variations in the conditions or relative rapidity of cooling the various surfaces, as, for example, by revolving castings in the mould during the process of cooling, or by retaining the heat somewhat on one side only; and also what effect the direction in which the crystals of cast-iron lie have upon the tension of the outside or surface skin and upon the wearing qualifications of the metal. Some slide-valves will cut, though faced and refaced, while a new valve will be found to work admirably. Now, whether the difference lay in the fact that the one cooled standing edgewise and the other with the face up or down, or whether such condition of cooling, affecting, as it does, the direction in which the crystals lie, also affects the wearing or abrading qualifications of the metal, experiment alone can determine.

FIRE-PROOF CONSTRUCTION.

By N. H. Hutton.

An investigation of the most trustworthy accounts of the Chicago and Boston fires shows that in both cases there were two (and only two) materials that to any extent resisted the disintegrating action of the furious heats; and that these were "brick" and "mortar." Mr. Wight further informs us that, even where the bricks showed signs of failure, the mortar was found uninjured. It is mainly from these two abundant and cheap materials, I would suggest, that our future fire-proof construction is to be developed; and that, not by reverting to the massive vaults and piers of a bygone day, but by using these materials in accordance with the teachings and experience of the science and facts of to-day.

I would propose, for the main masses of all walls, as well as floors, stairs, and flat roofs, wherever it is desirable to attain the highest degree of protection against fire, the use of hydraulic concrete of cement, sand, and stone; or the Béton Coignet, which is a concrete of cement and sand, mixed with a minimum of water; the walls of course to be faced with brick, or any kind of stone desired. These materials, if their use should become general, can be applied at half the cost of good brickwork, and will thus enable us to double the thickness of our walls without any additional expense. We obtain, moreover, damp-proof monolithic masses, without break or joint from top to bottom—an advantage that every constructor will recognize. The walls should be built hollow; as this, while increasing their statical strength, affords a convenient space for the passage of gas and water pipes, and permits us to dispense with lathing to the walls. One finishing coat of plaster is all that is required; and, if the fine "Béton Coignet" is used, the surface can be at once finished in fresco. As before remarked, they should extend well above the roof, at least four or five feet.

Floors of twenty-five feet span, and capable of withstanding the severest strains, can be formed in single spans of "Béton Coignet" without endangering the stability of the walls, as arches of this homogeneous, jointless material act chiefly as beams, and exert very little horizontal thrust. Stairways of any degree of ornamentation can likewise be executed in this material, and should be built in with the walls as they progress. Partitions should be constructed of hollow bricks or some other light and fire-proof material. Possibly one of the best will be found a combination of gypsum and sawdust, which I have heard reported to have been tried with success in New-York. For flat roofs I would suggest the use of flat arches of the "Béton Coignet" covered with a layer of "asphalt." Where the much-abused "mansard" style is adopted, it will be essential to use some form of framing of iron with covering of slate—Béton or terra-cotta: the latter I should think preferable.

In such cases as forbid the use of the system of single-span arches for flooring, wrought-iron beams carrying arches of concrete would seem to be the next best method. These should be supported on continuous corbelling, thrown out from the walls as they are built. In the use of beams for such purposes I would call attention to a form of beam used in Europe, but not, in so far as I am aware, as yet introduced in this country. It is called after its inventor the "Zorée girder," and is shaped very much like an "A" without the cross-bar. Some experiments made on these beams during the Paris exposition are reported as showing that one of these beams 4¾ in. deep, weighing 9.5 lbs. per ft., gave equal strength and stiffness with I beams 8¼ in. deep, weighing 16.9 lbs. per ft. If this be true, the great advantage to be derived from the use of this form is evident. Their shape undoubtedly offers the advantage of not requiring lateral support or stiffening, without which the I beams are comparatively weak and should never be used. Where iron columns are used, they should be double, having a space of an inch or two between, filled with plaster or cement. A recent invention consists in casting the columns with "slots," through which an interior filling of cement is forced, forming rough keys for a coating of plaster or cement which is made to envelop the whole column.

Stairways, if not of masonry or concrete, should be of iron, for manifest reasons; the absolute necessity of their being preserved uninjured, to render possible the escape of any persons caught in the upper portions while fire is raging below, being not the least among the many.

These remarks, though especially intended to apply to public buildings and those used for business and manufacturing purposes, apply equally to dwellings used exclusively for domestic purposes. I feel confident that if the experiment is once tried, of building really substantial dwellings of the materials I have referred to, none others will thereafter be constructed. Aside from their safety against fire, the immensely increased comfort and health, the saving in fuel, and cost of repairs, insurance, etc., will forever recommend them alike to capitalist and housekeeper. Should it be deemed impracticable or unremunerative to build as I have described (though I claim that a trial will show here, as it has done in Europe, that the first cost of this kind of construction is hardly any in excess of the usual flimsy methods), a great deal can be done in the way of improvement on the present styles, without any radical change in the general methods or material.

In the south of Europe, and I believe also in France, much of their immunity from the ravages of wide-spread conflagration is said to be due to the hardness of the material used for plastering, and the very thorough and efficient manner in which it is done. We know that both lime and gypsum are low conductors of heat; and it has occurred to me, that if we could obtain and use freely to cover the wooden portions of our dwellings an inexpensive material for plaster that would be so dense and strong as to permit its use in thick coats, without danger of its being injured or broken by concussion, we could thereby effect at no additional cost a very considerable degree of protection against the rapid spread of fire. This material has, I think, been discovered in the "selenitic" method of Col. Scott, of the English Engineers, by which he makes out of ordinary lime, by the admixture of a small quantity of the sulphate, generally in the form of gypsum, a cement which excels in strength and hardness the celebrated "Portland" cement. This prepared lime forms so hard a mortar that bricks joined together with it will separate by

fracture of the bricks, rather than through the mortar joint. I would therefore suggest for use, in even the cheapest houses, very heavy coats of this mortar in place of the ordinary kind used for plastering, and that all exposed joists and beams be incased in it. The "stopping-off" with this material at each floor level of all wooden partitions would also be an undoubted advantage. One of the greatest sources of danger from fire in our ordinary dwellings arises from the defective construction of hearths. These should always be formed over arches of masonry or concrete; and the greatest care should be exercised to see that the trimming joists do not approach too near the fireplace or flue.

For roof coverings and damp-proof courses, as well as for floors where appropriate, one of the most invaluable articles is the "European asphalt." This material is entirely waterproof; and not only fireproof, but, when used as a floor, it has been known to extinguish a fire burning below it, by falling on and smothering it. This may appear singular conduct for a "bituminous" substance, but we have ample proof of its being true. In one case in Paris, the stables of one of the principal omnibus companies had a floor covered with this material to prevent the smell of the stable from penetrating through from below; and on *five* different occasions it delayed the progress of the flames arising from the burning hay, until means of extrication could be applied.

AN INNOVATION IN ROOF CONSTRUCTION.

At a recent meeting of the Manchester Scientific and Mechanical Society, Mr. E. Grimes read a paper on the above subject.

The author, in the course of his paper, said recently he had observed that designers of roofs, both architects and engineers, had departed from the old plan of fixing purlins with their upper surfaces parallel with the plan of the roof, and their sides perpendicular to the same, and, instead thereof, had placed them in a position with their sides vertical and their upper surfaces level. He was not quite sure, but he had reason to believe, that engineers first adopted this arrangement and that architects followed suit, presuming, doubtless, that any change made by engineers, who were usually supposed to possess superior mathematical knowledge, could scarcely fail to be right. In his opinion, however, this new mode of construction was incorrect; and, indeed, it would require very little consideration of the forces brought into action in constructing a purlined roof to demonstrate that the practice universally adopted from time immemorial was the mechanically correct one. His attention was attracted to the new arrangement and its results on the occasion of a visit to the Birkenhead Docks. Passing through one of the large coal-sheds he observed that the purlins of the roof, which were of timber (although the principals were of iron), and of great length, were trussed with iron rods and placed vertically. These were in many cases bent considerably by the weight of the roof coming in a horizontal direction, and one or two of them was so much bent that the middle portion of the trussing rods which had been upset and hollowed to form a seat for a large plate stud, were forced aside from their place on the stud to a considerable distance. Looking on the outside of the roof, it was at once apparent that there it had sagged, as they termed it, and was a hollow plane. Since that time he had observed several roofs having vertical purlins, and presenting similar results. It appeared to him that the error had arisen from supposing that gravity was the only force necessary to be resisted, in which case, doubtless, the placing a purlin in a vertical position would be the strongest way. This, he contended, was not the fact, the force opposed to gravity coming into play and necessitating the strongest section of the purlin to be placed in a line with the resultant, and perpendicular to the plane of the roof.

HOMES IN AMERICAN CITIES.

The report of the Committee on Social Economy, at the late meeting of the American Social Science Association, contained the following suggestive review of the dwelling-house accommodations of the inhabitants of our leading cities:

"In general terms it may be said that there were in 1870, when the last national census was taken, about sixty cities in the United States with a population exceeding 25,000, of which seven—New-York, Philadelphia, Brooklyn, St. Louis, Chicago, Baltimore, and Boston—had each a population exceeding 250,000, and seven more—Cincinnati, New-Orleans, San Francisco, Buffalo, Washington, Newark, and Louisville—had a population of more than 100,000 each. The aggregate population of the first-named seven then somewhat exceeded 3,200,000, New-York alone containing 942,292. The aggregate population of the second group of seven cities do not quite reach 1,000,000, Cincinnati, the largest, containing 216,239 inhabitants. The remaining cities of the sixty had an aggregate population of about 2,000,000, so that the whole urban population of the United States dwelling in towns of more than 25,000 people was not far from 6,200,000, or nearly one sixth part of the whole population of the United States. So rapid is the increase of our urban population, however, that in the present year 1875 the eight cities now containing more than a quarter of a million inhabitants each have an aggregate population of not less than 4,000,000; the ten or twelve cities now containing more than 100,000 inhabitants each have an aggregate population of more than 1,500,000, and the seventy or eighty cities now ranging above the 25,000 standard have probably more than 8,000,000 inhabitants, or nearly one fifth of the whole present population of the United States. Ten years hence it is probable that the United States will have a hundred cities larger than Boston was at the beginning of the century, and that nearly a fourth part of all our people will dwell in such cities. Hence the great and growing importance of the question we are now considering—the ownership, situation, and quality of the homes in which so many millions of our people are to live and where their children are to be brought up. Shall they be tenement-houses like those of New-York and Boston, in which so many of the industrial classes now dwell, or shall they be smaller houses in better localities owned by the occupants, like the humble homes of Chicago, Philadelphia, Syracuse, Detroit, Worcester, and so many of the smaller American cities?

"In answering this question, each city will have to consider its own needs and possibilities, varying greatly as these do, but it will also be well to consider attentively the means by which Philadelphia, now a city of more than 750,000 inhabitants, has provided for its industrial population better homes than any large city in the world can show for an equal number of workingmen and small tradesmen. In several of the States which contain large cities a census has been taken in 1875, and we are therefore able to give statistics of the ratio of occupants to dwellings somewhat later in these States than in others. Massachusetts, New-York, and Rhode-Island are those from which we at present have returns, and in most of the cities of these States we find that overcrowding is on the increase. Here in Boston, where it seemed checked by the large annexation of suburban territory, it has lately begun to increase again. And in some of the manufacturing cities and towns of Massachusetts it is even greater than in Boston, to judge from the census returns, though not so great as in the worst parts of Boston. Thus in Boston, as a whole, there are 320,000 inhabitants and 40,817 occupied dwellings, at the rate of 8.4 persons to each dwelling, while in the old Wards, 2 and 7, the rate is as high as 12.2 and 11.7. In Fall River there are 45,340 inhabitants and only 4192 occupied dwellings—10.8 persons to each house. In Holyoke there are 16,260 inhabitants and only 1462 occupied dwellings—11 persons to each house. The town of Adams, in Berkshire County, has eight persons to each house; the City of Lancaster, 8.3 persons; the City of Worcester, 8.2 persons. In all, or nearly all, these places the ratio has risen since 1870. In Providence there are 100,675 inhabitants, and 12,954 occupied dwellings, or 7.76 persons to each.

"The contrast between the two largest American cities—New-York and Philadelphia—in this respect is very marked, and in the highest degree unfavorable to New-York, where also the condition of things is growing worse, while in Philadelphia it is growing better. By the census of 1870 the number of dwellings in New-York was about sixty-four thousand and forty-four for a population of nearly a million—an average, therefore, of nearly fifteen persons to each dwelling. But in nine of the twenty-two wards of New-York a population of 365,000 was housed in only 17,110 dwellings, an average of 212 persons to each dwelling. When Paris, in 1835, contained about the same population that New-York now numbers, the number of houses there was 50,476, and the number of persons to each dwelling was twenty-two, or just about the same overcrowding that we find in the worst parts of New-York. In Philadelphia, on the other hand, a population of 674,000 in 1870 was housed in 112,366 dwellings, giving one house to every six persons, while in the worst parts of Philadelphia the average number of persons to a dwelling did not much exceed eight, or only a third part of the New-York average, which, in one ward of nearly one hundred thousand, was more than twenty-four persons to each dwelling. The number of dwelling-houses built in Philadelphia since 1870 is about 24,000 (at the rate of a little less than 5000 a year), so that the present number of dwellings in that city is upward of 135,000, which, at an average of six persons to each dwelling, would give a population in 1875 of 810,000. This is more than the estimated population of the city, and therefore the proportion of dwellings to population has been increasing there—the very result we should expect from the system of building pursued in Philadelphia, and the very opposite of what is taking place in New-York. In other cities the contrast is not so striking; in Boston, for example, in consequence of successive annexations of suburban territory, the proportion of persons to each dwelling in the whole city has considerably diminished in thirty years, and does not now much exceed eight persons to each dwelling. In certain wards of Boston, however, the proportion is about double this, and there are 100,000 of the present population of Boston housed at the rate of twelve persons to each dwelling.

"Taking together the three cities of New-York, Brooklyn, and Jersey City, there was an aggregate population of about 1,421,000 in 1870, living in less than 120,000 dwellings (one for twelve persons); at the present time it is probable that these three cities contain more than 1,700,000, occupying no more dwellings than are found in the single city of Philadelphia, with less than half the inhabitants. The results of this overcrowding are perfectly well known, and painfully obvious in New-York."

MIRAGE IN NORTH-CAROLINA.

The Newbern (N. C.) *Times* says: "On Saturday, December 22d, quite a mirage occurred over the sounds of this State. From on board a vessel lying at Hatteras Inlet, the following light-houses were visible, namely: Ocracoke light-house, distant sixteen miles; Cape Hatteras light-house, distant thirteen miles; Long Shoal light-house, distant twenty-two miles; Royal Shoal N.W. and S.W., distant twenty-three miles; Harbor Island light-house, distant thirty miles; Brant Island light-house, distant thirty-one miles; Neuse River light-house, distant forty-four miles. Also, all the coast-survey tripods about the sound from Long Shoal to Pamlico and Neuse Rivers, and most of the buoys, even a common spar-buoy off Gull Island, distant twenty-six miles. All objects appeared inverted. While such an unusual vision occurred inside the coast, another equally peculiar phenomenon was apparent from the ocean. Vessels in approaching the land would make objects near the sea level long before they could discover higher objects, such as the tops of trees, light-houses, coast-survey signals, etc. In one instance the base of the light-house at Cape Hatteras, with the dwellings, were first seen, then the painted stripes above on the tower, and subsequently the top of the tower came in view. The weather was cloudy, wind light from the east, or calm, barometer 30.49, thermometer 56°. There was also an unusually low run of tide, and flats seldom seen were left bare."

CAMERON'S JOURNEY ACROSS AFRICA.

In a letter written at Kalembe, 11 deg. 31 min. south, 20 deg. 24 min. east, September 7th, Lieutenant Cameron gives the following summary of his work after his departure from Ujiji:

First, from Ujiji I went to Nyangwe by what I suppose was nearly the same route as that which Dr. Livingstone followed. I found that he had placed Nyangwe ninety miles too far to the west, and that thence the Lualaba, far from leaving its westing and turning to the north, really leaves its northing and turns to the west. Further down in its course it was reported to flow west-southwest. Some of the Arabs had been far away to the north-northeast, into Ulegga, and had heard of Egyptian traders from the natives, but had heard nothing of the Albert Nyanza, though some of them knew of it when I asked about it from previous journeys to Karague, etc. I am disposed to think that it is much smaller than it is drawn by Sir Samuel Baker. A river, said to be as large as the Lualaba, at Nyangwe, joins it a short way further down from the northward, besides other important rivers from the northward—possibly this river (the Lowa) may be the lower course of the Buri. The Lualaba at Nyangwe is only 1400 feet above the sea, or 500 below the Nile at Gondokoro, and lies in the centre of an enormously wide valley, which receives the drainage of all this part of Africa, and is the continuation of the valleys of the Luapula and Lualaba. I tried hard to get canoes at Nyangwe, but without avail, and after some time spent in vain attempts went with Tipo-tipo to his camp, to try and work my way from there to a lake, Sankorra, of which I had also heard at Nyangwe, into which the Lualaba falls, to which trouser-wearing traders are reported to come in large sailing boats, to buy palm-oil and dust packed in quills—which may be gold-dust. However, when I arrived at Tipo tipo's camp, the chief on the other bank of Lomami refused me a passage. Finding this road blocked I set off to the southward for Kasongo's (who is the big chief of all Urua, and to whose town Portuguese traders were reported to come), in the hopes of being able to make a road from there to the lake.

From Nyangwe to Kasongo's my route was principally up the eastern side of the valley of the Lomami, which is a minor valley in the great one of the Lualaba. The Lomami has no connection with the Kassabe, as shown in the map published by Keith Johnston, but is a separate and independent stream. It receives many brooks from the eastward, but no large rivers on that side; on the west it receives the Luwembi, coming from a lake called Iki, which is probably the Lake Lincoln of Livingstone, which receives the Lubiranzi and Luwembi, both considerable rivers. The Lualaba mentioned as such by the Pombeiros is the true Lualaba, and the position of its sources as laid down from their route may be taken as fairly correct. It then runs north-northeast through two large lakes, the Lohemba and Kassali, and in a third of smaller size, called Kowamba, receives the Lufira, from the south-southeast. Between Lufira and true Lualaba lies Katanga, a district rich in copper and gold, and with a marvellous abundance of game, if all reports be correct. A short way above the junction of Lualaba and Lafira are two other lakes, Kattara and Kimwera, but their connection and position with regard to the rest of the water system I have not been able to make out very clearly, but I believe Kattara to be to the west of the Lufira, and Kimwera to be between it and the Lualaba. Above Lake Kassali the Lualaba receives the Luburi, or Luwuri, and Lufupa, and the Lovoi falls into the lower end of Kassali. Below Kowamba the united rivers, now known indifferently as Kamorondo and Lualaba, flow through a chain of small lakes, commencing from south, Kahanda, Ahimbe, Bembe and Ziwambo, and are then joined by the Lualaba of Livingstone, which is properly called the Luvwa, but the Arabs usually call it the Lualaba; below their junction the united rivers flow through Lake Lanji (the Ulenge of Livingstone), and on past Nyangwe, where the name of Lualaba is corrupted into Ugarrowwa by the Arabs. The Kamorondo receives from the east, commencing from south, the Kalame Hongo (probably Cavula Ngango of Pombeires), Mana, Mkotwe, Kasamba and Kisuvulungo; and from the west, Luvijo, Kuwi, Losanzi and Luvunguwi, all considerable streams. Below the junction of the Luvwa and Kamorondo the following streams fall into the Lualaba before reaching Lake Lanji from the east: The Lumbji, probably the river passed by me as the Luwika on my road to Nyangwe; above their junction the Liambanji and Lukuga, the latter from Lake Tanganyika. Below Lake Lanji the Lualaba receives from the east the Luama and Lulindi, besides many minor streams. Beyond Nyangwe from the north, the Lila, the Lindi, and the Lowa; the last is said to be as large as the Lualaba at Nyangwe, and to receive two large streams, both called Lulu. Between Nyangwe, and Lomami, the Luvubu and Luwik, or Kasuku, fall into the main stream from the south. Beyond the Lubiranzi, two large rivers, the Luilhu and Buzimani, flow north into Lake Sankorra. Since leaving Kasolwo's we have crossed the Lovoi, the sources of the Lomami, Luwembi, in longitude 23 degs. 20 min., the Lukoji, in 23 deg. 10 min., the Luwati, both large streams, falling into the Lulua, whose sources we passed in longitude 23 deg.; close to the sources of the Lulua we came upon water going to the second Africa River, the Zambezi, whose sources may be placed in 23 deg. east longitude and 11 deg. 15 min. south latitude; the Lulua rising in 23 deg. east and 11 degs. south. Since then we have come across a great table-land with numerous streams, some going to Kassabe, and some to the Liambai, or Liambeji, as it is also called by the natives. We have now for three marches being following the left bank of the Lumeji, and have just come off the great plains. The Lumeji is a very considerable stream, and an affluent of the Loena, the source of which I hope to pass in front, and which falls into the Liambai. The Kassabe has been at a distance of from seven or eight to twenty miles to the north of us for the last eleven marches, during which we have maintained a generally westerly direction. The Kassabe commences its northing in about 22 degrees east, running up between the frontiers of Lovale and Ulunda. I can scarcely trust myself to try and clear up the confusion of names arising from the frantic distortion and mutilation of native names by the half-caste Portuguese traders. However, I may say that Luvar of the Portuguese is our Urua and the Urua of the natives also. Lovale is an entirely different country, lying between 20 deg. and 22 deg. east longitude, peopled by a different race, speaking a very distinctly different language. I can hear nothing of the Mosshamoa Mountains, though I have asked repeatedly about them, but am always told that there are no real hills this side of the Kwanza (or Coanza), though the Kassabe in the middle part of its course flows through a moderately hilly country.

On the 17th of September, Lieut. Cameron, then near Peho, country of Kebokwe, wrote a second letter, which with the foregoing was overtaken by him before reaching the coast, and forwarded with another letter written at Loanda, November 22d. He was then just recovering from an attack of scurvy, and did not furnish any details of the geography of the latter part of his route. He reached the coast at Katombela. Of the general aspect of the country traversed he writes: "The interior is mostly a magnificent and healthy country of unspeakable richness. I have a small specimen of good coal; other minerals, such as gold, copper, iron, and silver, are abundant; and I am confident that with a wise and liberal (not lavish) expenditure of capital, one of the greatest systems of inland navigation in the world might be utilized, and in from thirty to thirty-six months begin to repay any enterprising capitalists that might take the matter in hand. Another expedition I should be able to carry out with twice the comfort and half the expenditure of this one. *Nutmegs, *coffee, *semsem, *ground-nuts, *oil palms, the *mpafu (an oil-producing tree), *rice, wheat cotton, all the productions of Southern Europe. *India-rubber, *copal, and *sugar-cane are the vegetable productions which may be made profitable. Those marked with an asterisk exist there now, and wheat is cultivated successfully by the Arabs, as well as onions and fruit-trees brought from the coast. A canal of from twenty to thirty miles across a flat, level country, would connect the two great systems of the Kongo and the Zambesi—water in the rains even now forming a connecting link between them. With a capital of from £1,000,000 to £2,000,000 to begin with, a great company would have Africa open, as I say, in about three years, if properly worked. What the diplomatic difficulties might be I of course can not say, but I expect they would be far greater than the physical ones.

THE TERMITES OR WHITE ANTS OF AFRICA.

THE various species of ants, most abundant under the tropics, but found in all temperate regions, constitute what has been aptly termed the scavengers of nature. Their normal mission in the great economy, especially in climates where vegetation is abundant, seems to be the clearing away of fallen and dry trees and plants which might otherwise arrest new vegetation. Among the most remarkable insects of the antspecies is the family of the Termitidæ known in some of its genera in nearly all except the frozen latitudes; but especially remarkable in its celebrated representative the warlike termite (*Termes Bellicosus*) of Africa.

Four individuals represent the population of the castles of the termites: the male and female, one only of each; the workman, who represents the swarm of the population; and the soldier, whose proportion is about one in a hundred of the whole family. The workers construct the cone or pyramid in which the community resides. They also provision the fortress, and take charge of the eggs of the queen and of the young as they emerge from the egg. The soldier has a head in such great disproportion to the size of his body, that it seems to drag on the ground. It is armed with a mandible furnished with powerful forceps. The soldier shows alacrity enough when a breach is made in the castle-wall, rushing out and seizing by the forceps whatever it encounters. Fastened upon the flesh of man or other animal, the soldier never releases his hold, but must be killed on the spot to which he attaches himself.

SOLDIER.

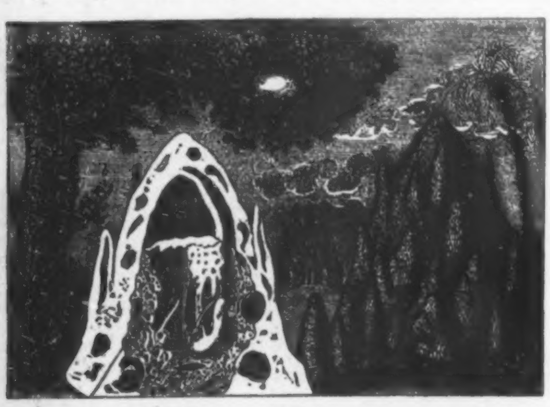
MATE, WITH WINGS.

The workmen commence with a single cone, of moderate size. Others are built near the first and around it, and the spaces between them filled in, the centre turret being always kept highest. The mound reaches at its completion a height of from twelve to fifteen feet, and becomes covered with herbage from seeds blown by the wind. The structure is so solid that wild cattle stand sentry upon it, and travellers climb the elevation to extend their view of the landscape.

In the centre of the lower part of the structure is the royal chamber, shaped like an elongated oven—small at first, but enlarged as the growth of the queen requires. From this chamber the pair never emerge, the entrances admitting the laborers, but being too small for the prisoners to escape at. On the floor of this chamber, the queen, in full bearing, lies like a huge white pudding on the floor of an oven. The length of her abdomen, at first less than half an inch, increases to three, four, and even eight inches, by about an inch in breadth. All motion on the feet becomes impossible. Near her majesty, and overshadowed by her immense bulk, abides the king, encouraging her perhaps in the labor of oviposition. The great sack of eggs to which the insect has grown is agitated by constant peristatic contractions, causing the continual deposit of eggs. Fruitful queens are computed to lay sixty eggs a minute, or more than eighty thousand in twenty-four hours.

The workers, or nurses, seem to trouble themselves very little about the king, but are very assiduous in their attentions to the queen, bringing her food, and removing the eggs to the nurseries, or hatching apartments. They are devoted servants to her majesty, who, without metaphor, is the mother of her people. The young, as they issue from the eggs, seem to find their first food upon a small mushroom growth which lines the walls of the hatching apartments.

Beneath and around the nurseries are the magazines of provisions; and over all, under the dome, is an air-chamber. (See engraving.) The floor of this chamber is impervious to water. Should the roof leak, the water which falls in the chamber is led off by conduits, which lead it below the lowest apartments of the castle. These passages, some of which are a foot or more in calibre, form with lesser passages the interior communications of the building, and are spiral to be of easy grade. Some of them extend under the surface outside, forming the subterranean approaches to the castle. It has no others. The air-chamber is supposed to equalize the temperature of the structure for the twenty-four hours.



NEST OF THE WARLIKE TERMITES AND THE TERMITES OF THE TREES.

Comparing the relative size of the working termite and the workingman a quarter inch and six feet or thereabouts, the ant-hills of the termites are more marvellous than cathedrals. Smeathman computes the Great Pyramid equal to one fifth of the height and solidity of the castle built by these industrious workers.

After the first great rains which succeed the dry season in the tropics, the male and female termites from the new progeny, furnished with great, gauze, reticulated wings, come forth in a cloud from their castles. They fly in the night for the houses and the ships at anchor, attracted by the lights. In the morning, the water and the earth are covered with them, despoiled of their wings. Those which have fallen on the ground run like swarms of ants, but are helpless, and become the prey of many animals, the ants of other species included. For while other ants have a hard shell, the skin of the termite is soft and tender. The Africans gather them from the water surface with calabashes, and roast them like coffee, eating them with infinite relish. Even Smeathman pronounces them edible. The laborers and soldiers collect the surviving males and females, and lead them by the subterranean passages to the hillocks. In couples they become the founders of new colonies and of edifices designed for their innumerable posterity.

Another variety, described by Smeathman, is the Tree Termite, which constructs a nest of woody fibre, sometimes as large a barrel, in the trees, seventy or eighty feet from the ground. The nest is reached by a covered way of clay, winding round the trunk of the tree, as seen in the engraving. It is conjectured that these ants have a subterranean retreat, to which the tree-nest is an outstation, as no queen has ever been discovered in the nests, where the insects are packed like herrings in a barrel.

NOTE.—The above is a free translation from *La Nature*, with the omission of some and addition of other matter. H. M. Smeathman published in London (Philosophical Transactions), in 1781, "Some Account of the Termites in Africa." Nearly a hundred years which have elapsed since then have added very little to our actual knowledge. The account above given of the demeanor of the workers towards the king and queen respectively in the royal chamber would seem to be an employment of the imagination as a factor in scientific investigation; as would also his majesty's royal condescension and anxiety; to say nothing of other suppositions which we have not thought it necessary to reproduce.

The termite is a member of the Neuroptera family, with *imperfect* metamorphoses; imperfect because when the insect leaves the egg it undergoes no transformation which confuses identity, as in the case of the catterpillar and butterfly. Some naturalists add another to the four individuals mentioned above as found in the community; the nymph, or pupa, differing only from the larvæ or workers in the possession of the rudiments of wings. The probability is that the metamorphosis is imperfect as regards the whole community, as well as the individual. The workers are larvæ who never go beyond that stage. The nymphs are a stage farther advanced towards the perfect insect, which comes out full winged, male and female. Of the swarms that fly forth, their form perfected, very few survive—not one in thousands. One purpose of their existence is to furnish food for other creatures; and this they seem to do, in their perfect form, as liberally as fish do in their spawn. The termite advances to its perfect limit beyond the egg before he becomes food for man and bird and insect. None of the insects which undergo transformations can provide for the continuance of their species till they reach the winged state; and many classes survive in their winged condition just long enough for that purpose. The queen-mother of the termites has a longer duration of fecundity; but, like her cousins, the common ants, she drops her wings when she goes to egg-bearing.

EXPLORATION IN SOUTH AMERICA.

THE following petition has been presented to Congress by Don Ramon Paez, whose fitness for the proposed work of exploration is certified by Peter Cooper, Cyrus W. Field, James Gordon Bennett, Royal Phelps, Morris Ketchum, and other prominent citizens of New-York, and also by the Consuls-General of Nicaragua, Mexico, and Peru:

To the Honorable the House of Representatives, etc.:

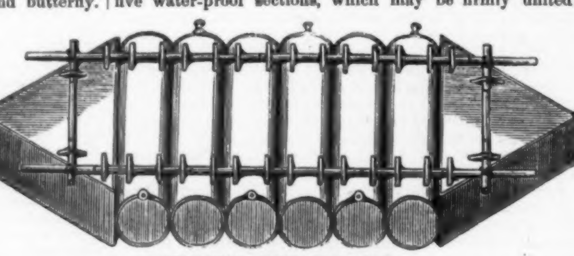
The undersigned, long a resident and citizen of the United States, but a native of the Republic of Venezuela, represents that, although most of the countries of Central and South America have been visited, at various times, by scientific commissions of the United States, with a view to studying their natural and commercial capabilities, Venezuela, the one nearest to our shores, and perhaps the richest of all in natural and agricultural products, remains comparatively unknown to us. To such an extent is this the case that even the geographical divisions of the country, such as Laguayra, Puerto Cabello and Bolivar, are popularly confounded with Laguna (a port in Central America), Porto Bello (in Colombia), and the Republic of Bolivia, on the Pacific coast. Nevertheless, Venezuela ships to this country, through her ports named above, and that of Maracaibo, in coffee, hides, etc., more than double the amount of our exports to her, as is conclusively shown by the last report of the Bureau of Statistics. The enterprise, energy, and capital of our merchants have already brought to light and are developing the rich gold region of Venezuelan Guiana on the Orinoco. This is the region of the famous El Dorado, which the indomitable Sir Walter Raleigh sought to annex by force to the Crown of England more than two hundred years ago—an effort which eventually cost him his life. Yet this long-forgotten and romantic field of adventure, with the vast territory encompassing it, would have remained a perfect *terra incognita* but for the few North-Americans who have brought it into notice within half a dozen years. But much remains to be accomplished yet, both in mining and commercial enterprises, for this is a country watered by the great river Orinoco, second only in importance to the mighty Amazon, whose numerous tributaries have their rise principally on the Andes of Colombia and Venezuela. It is, therefore, with the view of exploring this region, as well as the mountain or coast range of Venezuela, bordering on the Caribbean Sea, as far as the Lake of Maracaibo, that the undersigned respectfully solicits the coöperation of the Government of the United States. This undertaking is fraught with vast advantages to the trade and industry of this country. For this purpose a government steamer of light draught and a competent commission of scientific specialists detailed on this service would be amply sufficient. The Government of Venezuela being at present in the hands of a most energetic and enlightened ruler, the undersigned feels certain that the commission would meet with all the assistance the country can afford, thus lessening the expenses of the expedition and adding greatly to the stock of information to be acquired by it. The threatening attitude assumed by Holland against that country in consequence of the closing of the ports of Coro and Maracaibo, and the illicit trade carried on through them by the Dutch island of Curaçoa, would be another important reason for the despatch of the proposed expedition to those waters in furtherance of American interests in that quarter, while on the Orinoco—as already stated—the large possessions acquired by citizens of the United States in mining lands and other property equally demand the Government's fostering care.

STANLEY'S PORTABLE BOAT.

AFRICAN DISCOVERY BOATS AND RAFTS.

AMONG the devices of the enterprising African traveller and discoverer, H. M. Stanley, were sectional boats and rafts, which he was enabled to transport overland, for the navigation of any rivers and lakes that he might encounter during his researches. These implements have enabled him to explore the interior waters of Africa, and give to the world many new and remarkable contributions to geographical knowledge.

The boat as here illustrated is, when put together, forty feet long and six feet four inches wide. It is composed of five water-proof sections, which may be firmly united by means of bolts and clamps. This craft, the largest that has yet floated in the rivers of interior Africa, has been christened the Livingstone.



STANLEY'S PORTABLE RAFT.

The life-raft, as shown in the second illustration, is of a form that might wisely be adopted for use nearer home. It is composed of six India-rubber pontoon-tubes, which may be inflated at pleasure by means of bellows. These tubes rest transversely on three keels, to which are lashed the poles shown above. The bow and stern consist of triangular compartments, and the whole during transportation may be packed in a convenient form. Its whole weight is three hundred pounds, which can be divided into five loads, of sixty pounds each.

NEW PROCESS OF TREATING WOOD.

By M. ROBLING, Scranton, Pa.

THE process consists in saturating the wood with moisture, preferably by steaming, and, while thus softened, subjecting it to repeated rolling, by which it is reduced in thickness and greatly extended in length, further moisture being supplied by drips of hot water or other means, to take the place of that which is squeezed out by the rolls. On the completion of the process the wood acquires great ductility and flexibility, and a general consistency approaching to that of leather.

Willow-wood is found to be well adapted to the purpose. Cotton-wood also answers well, and, in view of its great abundance, will be found preferable in some parts of the country. Various other kinds of wood may be used with good effect.

The wood is prepared in strips of any convenient width and length, and three quarters of an inch (more or less) in thickness. It is subjected to steaming in chambers, such as are usually employed for steaming wood, as a preliminary to bending or cutting the same, and when completely saturated and permeated by the steam, it is pressed between iron rolls, such as are commonly employed for rolling leather.

In order to keep the wood in a moist and saturated condition during the rolling process, I employ jets or drips of hot water, which are so arranged as to fall on the parts of the wood which are about to enter the rolls.

For some purposes it is found desirable to roll the wood at intervals, leaving intervening portions unrolled, and thus preserving their original strength and rigidity. Thus, for example, wood prepared for the manufacture of shoe-soles may be rendered flexible in places where the sole is required to bend, and may retain in other parts its full strength, stiffness, durability, and capacity for holding nails, etc.

In cases where the wood is to be rolled throughout it is found best to pass it through the rolls in a direction diagonal to the grain. This causes less violence to the transverse cohesiveness of the wood than if it be passed through crosswise of the grain. The effect in either case is to compress the wood and extend it greatly in length in a direction transverse to the grain. In this way I have successfully rolled out a strip three-quarters of an inch thick to sixteen times its original length, without separating it or destroying its tenacity. It thus acquires great flexibility, and is an excellent material for the manufacture of insoles for boots and shoes, and for many other purposes. Among other uses, I may mention, for example, that it constitutes a good material for window-curtains, being well adapted for rolling. It is also a good material for carpets. It may be combined with leather or woven fabrics in any manner, to impart greater strength or to give any desired surface. It may be strengthened by stitching, either with or without the addition of leather or a woven fabric, for any required purpose.